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From statistics published by the Bureau of Commerce and Labor, at Washington, it is seen that the production of rubber for the year 1900 was 57,500 tons, and that, for the year 1902, it was 54,000 tons, a decrease of seven per cent. The principal rubber-producing countries of South America—Brazil, Peru and Bolivia—produce now over half of the rubber output of the world, and the figures for these countries indicate an encouraging increase. The other important rubber-producing country is Africa, where there was a decrease. The present methods of harvesting rubber are exceedingly wasteful, the gatherers thinking nothing of the future, but only of obtaining the largest harvest with the least trouble. With proper methods, the supply should increase, rather than decrease.

THE EXPANSION OF THE TELEPHONE.

Statements are so frequently made nowadays of the wonderful progress of the industrial applications of scientific discoveries, that they attract only a passing comment, while the results of these applications upon our mode of living are almost always overlooked. An exception to this exists in the application of electricity to railway work, one of the most active lines of development, as the changes which the trolley is bringing about have certainly not suffered from a lack of public interest and newspaper notice.

Growing Use of the Telephone.

There is another field of electrical application which is as active as the electric railway, but which attracts little public interest. That is the telephone. Hardly a day passes in which several telephone companies are not incorporated in the smaller cities and towns throughout the country. All the larger cities have large installations, some of them having two. These installations are growing rapidly. Not only is the number of individual stations increasing, but every large business office has a branch exchange, every new apartment house has a telephone in each apartment, and every new hotel a telephone in each room. It would seem from this that the telephone, which long since became indispensable in the transaction of business, is fast becoming a necessity in conducting the affairs of the home.

How the Telephone Helps.

The result of this use of the telephone is to increase opportunities for transacting any affairs whether of a business or social nature, by making it possible for the telephone user to come into direct contact with a far larger number of people than he could reach by personal visits. In this respect the telephone resembles the postal system, but it avoids the delay and uncertainty involved in the use of the mails. It eliminates very largely the need of messengers and middlemen, bringing the individual at once into contact with headquarters. By bringing the producer and purchaser together, business can be transacted quickly and easily with a saving of agents' fees. It is said that, in the West, farmers find the telephone very useful, not only in conducting their household affairs, but in marketing their produce. Where formerly the farmer stored his grain in elevators, waiting for an advantageous time to sell, he now stores it himself, and, by means of market quotations which he receives over the telephone, disposes of his grain whenever, in his judgment, he can do so to the best advantage by means of his telephone; and he does this without loss of time or any exertion other than calling up his dealer. Moreover, he has the satisfaction of closing a bargain at once at the current prices. This is but a single instance, but it shows how the telephone is becoming one of the controlling factors in nearly all lines of business activity.

POSSIBLE RESTRICTION OF ELECTRICAL IMPORTS.

Russian manufacturers are taking steps to diminish the imports of electrical machinery and to increase the consumption of home products. A petition has been addressed to the Minister of the Interior and to the Minister of Finances, at St. Petersburg, by fourteen of the leading manufacturing establishments of Russia, in which the government is asked to require the municipalities of St. Petersburg and Moscow to order all electrical machinery and apparatus from Russian factories. The manufacturers hope that the result of this petition will be that the municipalities will be obliged to cease importing electrical machinery and other apparatus from foreign houses, and that the government will require all future contracts to be awarded to Russian factories. Such action would, of course, bar American, English and German apparatus from Russian municipal plants, and probably would have some effect on the imports for other purposes. The fate of the petition will be watched with interest in this country, though it will probably affect Germany more seriously should the policy advocated in it be adopted.

REMODELING ELECTRIC LIGHT PLANTS.

It was pointed out some time ago by a prominent electrical contractor, that a generation in electrical machinery is now only three years—that is to say, in three years electrical machines, new to-day, become old and out of date, and if a new installation were to be made, it would differ materially from the three-year-old plant.

Improvements Being Made Constantly.

New machines naturally show improvements and, at times, give evidence of important advances in the art. The efficiency and regulation of generators, and the life and economy of lamps, have increased steadily with improved design and better methods of manufacture, and it is to be hoped that this improvement will continue, although it must, of necessity, be at a diminished rate, unless some radical change is made in our methods of construction.

New Plants Better than the Old.

As a result of this advance, a station built to-day should, and does, if it is well designed, give a higher efficiency and a better service than would have been possible had it been erected and equipped several years ago. Such improvement is simply the healthy growth and development of engineering methods, mechanical and electrical, as it is the constant aim of the manufacturer and operator to improve his apparatus and his methods. We therefore expect not only cheaper machinery, but better machinery, cheaper service and better service.

Desire for the Best Plant.

Such being the case, the manager of an older plant naturally looks with longing upon the showing made by a present-day plant, and he begins to wonder whether he can not make a similar showing. He questions whether it would not be a wise move to scrap the old machinery or sell it for what it will bring, and buy new apparatus. The question may come up simply in the desire to improve the service and to reduce the expenses, or it may come up in connection with necessary enlargements and additions to the existing station. When purchasing new machinery it is, of course, desirable to secure the latest and best designs, and there may be some doubt whether new machines will operate to the best advantage when grouped with the old.

Will It Pay to Scrap the Old Plant?

The question of remodeling or rebuilding a plant requires the most careful consideration. The problem is usually submitted to an engineer, who studies it in all its phases. He must know what the old plant has been doing—which, presumably, is the best that it can do, and what it can be expected to do if retained. He must then figure out the cost of the new equipment. He must know on what terms the money necessary for the change can be secured, and he must make an estimate of what it will cost to operate the new machinery. Having done this, he then seeks answers to the following questions: Will the saving of the new plant over the old allow it to pay interest and depreciation on the outlay, and bring increased returns? Will the improved service so increase the output of the plant—and therefore the income—as to make the change a profitable one? Then other considerations may come up. It may be possible with a newer system to locate the plant at a more favorable position; or the selection of a different system, which will increase the efficiency of distribution, or increase the area in which distribution can be made profitably, may seem desirable. All these questions and many others must be examined, and while the question reduced to its simplest terms is, will the change pay? the answer can only be given after a careful study of all the features of both the old plant and the contemplated installation. The engineer's answer as given in his report is based on the best obtainable information, and it sometimes is in favor of the change, and sometimes against it.

Old Plants Changed to New.

A year or so ago such changes and improvements were not uncommon. In some cases there was, undoubtedly, no alternative—a new plant must be built. In some cases the change was certainly wise; in others it seems to have been thought good policy; and there were, doubtless, times when a change was made perhaps for no other reason than that it seemed to be the proper thing, because others were doing it. Unfortunately, the opinion of an experienced engineer was not always sought, the management taking the responsibility.

Investigating the Results of the Change.

To-day certain of these companies which made a change a year or so ago are investigating carefully the results of the change. They are endeavoring to find out how far the engineer's figures have been verified, and in what respect they differ from what was found to be the actual case. Such investigations are very valuable and helpful, and should be made by all companies which have made a change. There is no doubt that, in many cases—we might say, in most cases—the results will demonstrate the wisdom of the change. On the other hand, there will be found instances where the change has not been profitable. Such cases should be studied with a view of determining in what way the actual outcome differed from that in-

dicated in the engineer's report. It should be remembered that, in such cases, the engineer must make a prediction. Conditions may change. Difficulties which could not be foreseen may arise, and it may be found that, while the change did not bring the desired results, the results would have been much worse had the old plant been retained. But in any case, whether the change was successful or not, the full lesson should be learned; and it should not be the sole aim of such investigations to show that a good profit has been made, but, as well, how much better the results have been than if the old plant had been retained. And on the other hand, in those plants where the results are not as good as had been expected, every phase of the question should be investigated carefully.

THE EFFECT OF RADIUM ON THE CONDUCTIVITY OF LIQUIDS.

An interesting, and what may prove to be an important scientific announcement, was made recently by Professor Friedrich Kohlrausch, in regard to the action of radium rays in increasing the electrical conductivity of water. Experiments were carried out with rays which were emitted by bromide of radium and barium, and which, after passing through an aluminum screen, were sent through a layer of water. After an exposure of some time, it was observed that the conductivity of the water increased. To account for this two hypotheses are suggested: the effect may be due to the action of the radium rays upon the glass vessel, or there may be a direct formation of ions in the liquid.

Possible Effects of Radium Rays on Glass.

Both of these suggestions seem open to criticism. Glass is a non-conductor, and, unless decomposed, it is difficult to see what effect it can have upon the water itself. Any action of the radium which would affect the glass itself, so as to make it conduct, might cause an apparent increase in the conductivity of water, on account of the conductivity of the glass, while actually the water remained unchanged.

Possible Effects of Radium Rays on Water.

If the effect is due to the action of the rays upon the water, the question arises, in what way is this increased conductivity brought about? Pure water conducts but slightly, its conductivity being attributed by the German theory of solution to the presence of dissociated hydrogen and hydroxyl ions in the water. An increase in conductivity, according to this theory, can only be brought about by increasing the number of ions—that is, by causing dissociation to take place to a greater extent. But this dissociation is limited by the osmotic pressure of the ions in solution, which resists the tendency of molecules of water to dissociate. The effect of radium rays, then, must, according to this theory, either increase the solution pressure—that is, the tendency of the water molecules to dissociate—or decrease the osmotic pressure. But the osmotic pressure depends entirely upon the number of ions in solution, so that a decrease here would indicate a decrease in the number of ions, and, therefore, in the conductivity. On the other hand, according to Nernst, the solution pressure of a substance is a constant for a constant temperature. If the radium rays affect water in this way, will they not also affect other substances in the same way? If so, what effect will this have upon the dissociation theory? Radioactivity has already given chemists a bad turn in regard to the atomic theory, and it is not impossible that it may bring about some modification of electrochemical theories. May there be a true ionization taking place, so that there is an actual convection current due to the presence of charged particles or electrons, just as happens in the case of a gas?

DECORATIVE LIGHTING.

A branch of the art of illumination which has been created by the application of electrical methods is that classed as decorative lighting. This art, although of comparatively recent development, has grown rapidly, and now the question in illumination is no longer simply that of obtaining a requisite amount of light on the floor or table, but this light must be obtained in a pleasing and artistic way. Formerly, when lighting was accomplished by the use of flames, the requirements of the illuminant limited the effects which could be secured. The flame must always be in a vertical position; must be protected from drafts, but have plenty of air, and must be sufficiently far from inflammable material as not to be a source of danger.

Flexibility in the Use of Incandescent Lamps.

With the introduction of the incandescent lamp, these limitations were largely removed, the only one remaining being that of ventilation. Sufficient air must be supplied to the lamps to prevent heating. Since the incandescent lamp, in producing light, wastes a certain amount of energy as heat, this must be given up to surrounding objects, usually the air. When this requirement is met, there is no other precaution necessary, except to see that the work of installation is carried out satisfactorily, and the lamps may be placed wherever most effective or desirable, and the decorative effect may take any form.

Lighting by Concealed Lamps.

The lamps are made in an almost infinite number of types, some of which are, in themselves, highly ornamental. They may be used to good effect as part of the decoration of a room or building, or they may be concealed from view, allowing them to illuminate brilliantly surfaces from which the light is radiated to the points desired. This method of lighting affords opportunity for a great deal of study and the exercise of much skill in order to secure the best effects, and it is being used with excellent results in many instances. A good example of the art of lighting with concealed lamps is given by the new Lyceum Theatre, New York, where every light is hidden from view. To secure the desired amount of illumination in this way may necessitate the use of a large number of lamps, but this is merely the price paid for the end sought. The effects secured are most pleasing and beneficial as the illumination brought about in this way causes less strain on the eyes than that given by a number of brilliantly luminous lamps exposed to view, which can not fail to cause much strain and weariness.

GLASS VESSELS AND QUARTZ VESSELS.

BY DR. JOHN TROWBRIDGE.

The behavior of the hard Jena glass and of amorphous quartz, at high temperatures, promises to be of practical importance. It is also of scientific interest in spectrum analysis. The only method of submitting gases to very high temperatures consists in enclosing them in glass or quartz vessels and in sending powerful electric discharges through these vessels. In making such suitable vessels I found it desirable to use the oxy-hydrogen blowpipe with the hardest Jena glass; moreover, it was practically impossible to fuse this glass to the ordinary glass used in glass blowing—commonly called German glass. A crack would immediately start at the junction; but platinum would fuse with the hard Jena glass without the need of ordinary sealing in glass.

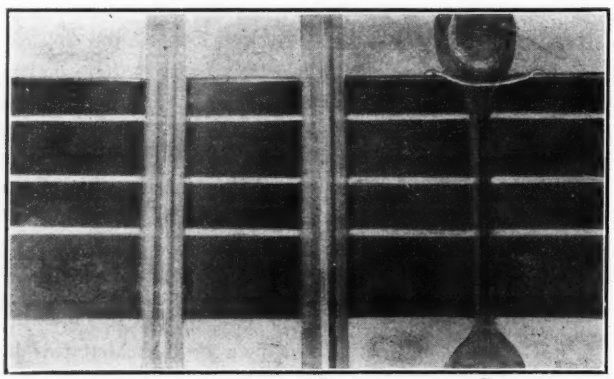


FIG. 1.

The oxy-hydrogen blowpipe is essential in working with quartz; and the quartz vessels differ from those made of the hardest Jena glass in two important respects. A powerful electric discharge sent through a capillary of the Jena glass corrodes the inner walls of the glass making these walls appear like ground glass. The same amount of electric energy sent through quartz capillaries leaves the inner walls of the quartz capillary perfectly limpid and apparently untouched by the electric discharge. The second difference consists in the behavior of quartz toward platinum; it is impossible to weld this metal with quartz. In order, therefore, to seal gases in quartz vessels it is necessary to use some form of cement. The accompanying illustration, Fig. 1, shows the behavior of German glass A, lead glass B and quartz C to practically the same temperature. The lead glass is strongly corroded by the electric discharge; the lead blackening the walls and producing an appearance like slag; while the German soft glass is finely roughened like ground glass; and the quartz is unaffected and remains translucent.

At very high temperatures one obtains a continuous spectrum with a very intense light. This continuous spectrum is not due to any luminescence of the glass or quartz. It could arise possibly from a luminescence of the contained gas; but from present indications it seems more likely that it results from the great pressure of the gas due to the explosions. At a point short of the appearance of the continuous spectrum, the hard Jena glass gives the spectrum of boron together with another spectrum partly gaseous and partly due to silicon. The accompanying illustration, Fig. 2, is this spectrum of Jena glass; 1 is the bright line spectrum of boron and atmospheric lines; 2 and 3 the continuous spectrum at a higher temperature; 4 the comparison solar spectrum. The spectrum obtained from German glass not containing lead is similar with the exception of the lines of boron which are absent. Quartz gives a spectrum of oxide of silicon. A continuous spectrum in the case of stars may be due to electric disturbances; and one should not conclude that there are not spectral lines of gases or metals; for they may be completely concealed by the continuous spectrum. There is a strong tendency at present to believe that the light of the heavenly bodies, including that of the sun, is due to electric agency rather than to a high temperature produced by combustion or contraction of gaseous matter.

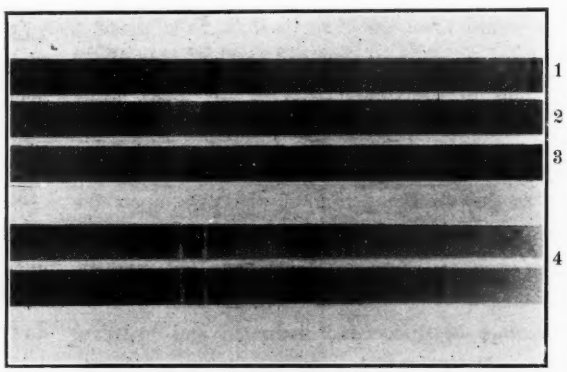


FIG. 2.

The powerful discharge from a large condenser charged from a storage battery of from ten to twenty thousand cells through rarefied gases contained in glass or quartz vessels produces a very different spectrum from that arising from condensers charged by a step-up transformer; even when the same voltage is employed. This fact arises probably from the much more sudden fall of potential when the condenser is disconnected from the battery and then discharged. In the case of the transformer the condensers are charged and discharged many times in a second and are only partially charged and partially discharged; remaining always in connection with the spark-gap.

In the use of glass and of quartz I have arrived at a limit of enquiry in regard to the high temperatures of gases; for as is seen from the accompanying illustration, a continuous spectrum sets in with a certain energy of electric discharge which completely obscures any gaseous lines or even metallic lines.

Report of Rates for Lighting and Power Service.

The National Electric Light Association has issued to its members a very comprehensive and valuable report on rates for lighting and power service in the United States. The report covers the entire country, and gives the prevailing rates for incandescent and arc lights and for power. It is not limited to data of member companies only, but includes many non-members. As this is the first report of the kind, it is not as complete as the association desires; but it was thought better to publish it while the information was fresh, and to issue later editions from time to time, as it becomes necessary. To this end, the members are invited to cooperate in the publication of the later editions, by sending in suggestions and data pertinent to the subject. The report is issued to members only, and is strictly confidential.

EXPERIMENTS FOR IMPROVING THE CONSTRUCTION OF PRACTICAL STANDARDS FOR ELECTRICAL MEASUREMENTS—II.

The committee have had under consideration the drawings and specifications for the ampere balance as designed by the late Principal Viriamu Jones and Professor Ayrton. The electrical parts of the instruments need construction under skilled supervision. Tests of various kinds have to be made continually, and the committee have come to the conclusion that this supervision can best be secured by having the instrument constructed in the workshop of the National Physical Laboratory, under the care of Professor Ayrton and the secretary, who, as director, will be able, with the assistance of the staff of the laboratory, to control the work in an efficient manner.

The committee are of opinion that further expenditure will be required in completing the set of platinum thermometers, in particular in providing a satisfactory resistance box and in carrying out the researches on the Clark cell. They consider that it is of great importance that these researches should be brought to a satisfactory conclusion. For these reasons they recommend that they be reappointed, with a grant of £60, that Lord Rayleigh be chairman, and Mr. R. T. Glazebrook, secretary.

TABLE I.

Year.	Flat. F.	Flat. G.	Flat. H.
1888	$+47 \times 10^{-5}$	$+91 \times 10^{-5}$	$+77 \times 10^{-5}$
1890	−17	+112	+90
1891	.....	.....	.....
1892	−18	+108	+92
1894	.....	.....	.....
1897	.....	.....	.....
1898	−36	+99	+69
1900	−47	+92	+63
1901	−42	+92	+70
1902	−33	+90	+76
1903	−33	+75	+76

increased. The observations recorded are in terms of B. A. Flat. Owing to a change in Flat taking place, however, the 1903 comparisons were made chiefly with Nalder 3,715. In table I the approximate difference in B. A. U. between Flat and the B. A. unit coils F, G, H of the association are given. Table II gives the difference in ohms between[1] (1.01358 × Flat) and other platinum-silver coils.

TABLE II.

Year.	(1.01358 × Flat). Nalder 3,715.	Elliott 264.	Elliott 269.	Elliott 270.
1888	.....	.....	.....	.....
1890	.....	.....	.....	.....
1891	.....	$+13 \times 10^{-5}$	.....	.....
1892	.....	.....	.....	.....
1894	-17×10^{-5}	.....	-37×10^{-5}	$+27 \times 10^{-5}$
1897	.....	.....	.....	.....
1898	−17	+9	−46	+27
1900	−17	+23	−49	+27
1901	−17	+23	−54	+27
1902	0	+38	−39	+44
1903	0	.....	−39	+44

TABLE III.

Year.	(1.01358 × Flat). Elliott 288.	Elliott 289.
1897	-27×10^{-5}	$+7 \times 10^{-5}$
1898	−27	+7
1902–3	−10	+24

Table III shows the percentage difference between (1.01358 × Flat) and the unit of two 10-ohm platinum-silver coils of the association at 16 degrees C.

The coils F, G and H are similarly constituted—they are the old B. A. coils made by Matthiessen. No. 3,715 is by Nalder Bros., and the remainder of the coils by Messrs. Elliott Bros. No. 264 is a coil belonging to the Board of Trade, and has been returned to Whitehall; hence there are no observations for 1903.

Tables I, II and III assume Flat to be constant. It will be observed that the differences of Flat and 3,715, 270, 288 and 289 are constant from 1897 to 1901. From 1901 to 1903 a change of about 0.017 per cent is evident between Flat and the coils 3,715, 264, 269, 270, and again between Flat and the units of the coils 288 and 289. This suggests a change in the value of Flat from 1901.

Since 1901 comparisons between Flat and the manganin standards of the association have been made. Table IV gives the observed values in ohms. The values of 1,690, 780, 381 and 147 diminish by 17, 15, 15, and 7 times 10^{-5} ohms respectively in the interval 1901-1902. No. 147 is known to be a variable coil of very low insulation resistance, and may be disregarded for the purpose of estimating the change in Flat.

It is of interest as being a coil brought to Cambridge by Dr. Lindeck in 1892 and left with the secretary. Thus the apparent falls in value of 3,715, 264, 269, 270, 288, 289, 1,690, 780, and 381 are respectively 0.017, 0.015, 0.020, 0.017, 0.017, 0.017, 0.017, 0.015 and 0.015 per cent, giving a mean of 0.017 per cent. This justifies the assumption of a rise in resistance of B. A. Flat of 0.017 per cent in the period 1901-1902.

The following tables V and VI are I and II revised. They take the change in Flat into account by means of corrections applied to the observations of the years 1902 and 1903. The values given are for 16 degrees C.

Tables VII and VIII being III and IV, similarly revised, show no marked

APPENDIX I—ON THE VALUES OF THE RESISTANCE OF CERTAIN STANDARD COILS OF THE BRITISH ASSOCIATION.[1]

BY F. E. SMITH.

Changes of very considerable magnitude have taken place since 1892 in the Temperature of observations, 16 degrees C.

[1] From the National Physical Laboratory. The report covers the period 1888–1903 inclusive.

[1] 1 B. O. T. ohm = 1.01358 B. A. U.

change in any of the coils in those tables excepting 147.

With reference to tables V and VI the data for 1901-1903 show a rise of 0.008 per cent for F, 0.034 per cent for G, and 0.011 per cent for H, indicating that they are certainly changing coils, the resistance for this period increasing with time. From the values recorded, 3,715 and 270, we have evidence that Flat has probably remained constant for the period 1894-1901. Also we infer that 264 is not a coil showing very great changes. Between the years 1892 and 1898 the differences between Flat and the coils F, G and H alter by the amounts 0.018 per cent, 0.009 per cent, and 0.023 per cent respectively. The dissimilarity of these percentage differences is further evidence that the coils have changed among themselves in this period. Comparing the amounts with those of the period 1901-1903, they represent quite normal increments of resistance. The balance of evidence in consequence is in favor of the constancy of Flat over the period 1892-1898, and this constancy has therefore been assumed.

A summarized statement of the platinum-silver coils of the association will be observed in table IX.

It will be observed that a number of the coils are steadily rising in value. The insulation remains good.

TABLE IV—VALUES AT 16 DEGREES CENTIGRADE IN TERMS OF (1.01358 × FLAT), ASSUMING FLAT UNCHANGED.

Year.	Wolff 1,690.	Wolff 780.	Wolff 381.	Wolff 147.
1901	1.00012	1.00002	1.00014	0.99790
1902	0.99995	0.99987	0.99999	0.99783
1903	0.99995	0.99987	0.99999	0.99783

TABLE V (I REVISED)—B. A. U.

Year.	Constant Flat.		
	F.	G.	H.
1888	$+47 \times 10^{-5}$	$+91 \times 10^{-5}$	$+77 \times 10^{-5}$
1890	−17	+112	+90
1891	.....	.....	.....
1892	−18	+108	+92
1894	.....	.....	.....
1897	.....	.....	.....
1898	−36	+99	+69
1900	−47	+92	+63
1901	−42	+92	+70
1902	−50	+73	+59
1903	−50	+58	+59

TABLE VI (II REVISED)—OHMS.

Year.	(Constant 1.01358 × Flat).			
	Nalder 3,715	Elliott 264.	Elliott 269.	Elliott 270.
1888	.....	.....	.....	.....
1890	.....	.....	.....	.....
1891	.....	$+13 \times 10^{-5}$	.....	.....
1892	.....	.....	.....	.....
1894	-17×10^{-5}	.....	-37×10^{-5}	$+27 \times 10^{-5}$
1897	.....	.....	.....	.....
1898	−17	+9	−46	+27
1900	−17	+23	−59	+27
1901	−17	+23	−54	+27
1902	−17	+21	−56	+27
1903	−17	.....	−56	+27

TABLE VII (III REVISED)—VALUES AT 16 DEGREES CENTIGRADE.

Year.	(1.01358 × Flat).	
	Elliott 288.	Elliott 289.
1897	-0.27×10^{-5}	$+7 \times 10^{-5}$
1898	−0.27	+7
1902–3	−0.27	+7

TABLE VIII (IV REVISED).

Year.	Wolff 1,690.	Wolff 780.	Wolff 381.	Wolff 147.
1901	1.00012	1.00002	1.00014	0.99790
1902	1.00012	1.00004	1.00016	0.99800
1903	1.00012	1.00004	1.00016	0.99800

TEMPERATURE COEFFICIENTS OF B. A. COILS.

Some special observations have been made in order to obtain the temperature coefficients of the coils. These were carried out by keeping the standard coil constant and subjecting the tested coil to various temperatures for twelve or more hours so as to ensure no lag. It is interesting to note that the temperature coefficients of some of the coils are appreciably different from the old values of 1892.

COMPARISON OF THE UNIT OF RESISTANCE EMPLOYED AT THE REICHSANSTALT AND THAT OF THE N. P. L.

By the N. P. L. unit is meant the unit of resistance as obtained from the old B. A. coils.[1] Assuming that all the changes have been successfully interpreted, the unit at present employed in the laboratory should be the same as that employed in the Cavendish Laboratory in 1898 and at Edinburgh in 1892. A comparison of the two units was rendered possible in the spring. Two Wolff coils, Nos. 780 and 738, of nominal values 1 ohm and 10 ohms respectively, were despatched to Germany last winter. Their values were determined in Reichsanstalt units (termed international ohms) in March, and the coils immediately returned to the laboratory. Unfortunately, both coils fell in value two or three parts in the hundred-thousandth figure during their journeyings. The values given in the table are those determined on their return. In addition, five new coils were received, varying in value from one-tenth to 10,000 ohms. These enabled a more complete comparison to be made. The laboratory value was deduced by building

[1] 1 N. P. L. unit = 1.01358 B. A. U.

TABLE IX—SHOWING THE PERCENTAGE INCREASE IN RESISTANCE OF B. A. PLATINUM-SILVER COILS FROM 1888.

Coil.	1888	1890	1891	1892	1894	1897	1898	1900	1901	1902	1903
Flat	..	..	..	..	..	..	..	..	..	.017	.017
F	..	.064	..	.065	..	..	.083	.094	.089	.097	.097
G	..	—.021	..	—.017	..	..	—.008	—.001	—.001	.018	.033
H	..	—.013	..	—.015	..	..	.008	.014	.007	.018	.018
3,715	..	..	..	..	*a*	..	0	0	0	0	0
264	..	..	*a*	..	..	..	.004	—.010	—.010	—.008	..
269	..	..	..	..	*a*	..	.009	.022	.017	.019	.019
270	..	..	..	..	*a*	..	0	0	0	0	0
288	..	..	..	..	..	*a*	0	..	..	..	0
289	..	..	..	..	..	*a*	0	..	..	..	0

a Observation commenced.

TABLE X—SHOWING THE OLD AND NEW VALUES OF THE TEMPERATURE COEFFICIENTS OF VARIOUS COILS.

Coil.	Temperature Coefficient Old Value, per 1 Degree Centigrade.	Temperature Coefficient New Value, per 1 Degree Centigrade.
Flat	0.000277 B. A. U.	0.000271 B. A. U.
F	286 "	268 "
G	274 "	274 "
H	271 "	280 "
3,715	0.000260 ? ohm	0.000307 ohm
264	312 "	283 "
269	.....	285 "
270	.....	315 "

TABLE XI—RESULTS OF MEASUREMENTS OF VARIOUS COILS AT THE REICHSANSTALT AND AT THE LABORATORY, MARCH, 1903.

Coil No.	Laboratory Value at 17 Degrees Centigrade.	Value Deduced from Reichsanstalt Certificate at 17 Degrees Centigrade.	Laboratory Value—Reichsanstalt Value. Percentage Difference.
2,352	0.100007	0.099996	0.011 per cent.
2,351	1.00011	1.00001	0.010 "
780	1.00001	0.99991	0.010 "
738	9.9994_5	9.9985	0.009_5 "
2,450	100.004	99.993	0.011 "
2,449	1,000.06	999.96	0.010 "
2,448	10,000.9	9,999.8	0.011 "

TABLE XII—RESULTS OF MEASUREMENTS OF VARIOUS COILS AT THE BOARD OF TRADE OFFICES AND AT THE LABORATORY, FEBRUARY AND MARCH, 1903.

Coil No.	Temperature.	Labcratory Value.	Deduced B. O. T. Value.	Laboratory Value —B. O. T.
Elliott 270.....	16.0°C.	1.00006	1.00010_5	-0.004_5 per cent.
Elliott 264.....	16.0°C.	1.00008	1.00014_5	-0.006_5 "
Wolff 381.....	16.0°C.	1.00015	1.00021_7	-0.006_7 "
Nalder 6,863.....	15.84°C.	999.13	999.1[a]	.....

TABLE XIII.

Coil.	Temperature.	Resistance.	Temperature Coefficient per 1 Degree Centigrade.
Flat	16.0° C.	1.00050 B. A. U.	0.000271 B. A. U.
F	"	1.00083 "	0.000268 "
G	"	0.99975 "	0.000274 "
H	"	0.99976 "	0.000280 "
3,715	"	1.00050 ohm.	0.000307 ohm.
269	"	1.00089 "	0.000285 "
270	"	1.00006 "	0.000315 "
288	"	10.0060 "	0.0031_0 "
289	"	10.0026 "	0.0026_5 "

TABLE XIV.

Coil.	Temperature.	Resistance.	Temperature Coefficient per 1 Degree Centigrade.
1,690	16°.0 C.	1.00012 ohm.	0.00001 ohm.
780	"	1.00002 "	0.00001 "
381[1]	"	1.00016 "	0.00002 "
147	"	0.99800 "	0.00001_5 "

[1] No. 381 is a manganin coil belonging to the Board of Trade.

up from the unit, and also by direct comparison with coils of similar value.

It is evident from these observations that a difference of 0.010_5 per cent exists, or that

Resistance of Reichsanstalt unit—resistance of laboratory unit = 0.00010_5 ohm. . . . . (A)

COMPARISON OF THE UNIT OF RESISTANCE EMPLOYED AT THE BOARD OF TRADE AND THAT OF THE LABORATORY.

The comparison of these two units is not so complete. Two platinum-silver units and one of manganin have been determined at both laboratories. The measurements taken at Teddington indicate that no change resulted during the journeyings of the coils. In addition one 1,000-ohm coil (Nalder 6,863) has been determined.

The exact relationship between the B. O. T. unit and that of the laboratory is, therefore, still incomplete.

It seems fairly certain, however, that—

Resistance of laboratory unit—resistance of B. O. T. unit = 0.00006 ohm, a difference of 0.006 per cent. . . . (B)

From the two relationships—

Resistance of Reichsanstalt unit—resistance of N. P. L. unit = 0.00010_5 ohm,

Resistance of laboratory unit—resistance of B. O. T. unit = 0.00006 ohm,

we have

Resistance of Reichsanstalt unit—resistance of B. O. T. unit = 0.00016_5 ohm, a difference of 0.016_5 per cent. (C)

The present values of the B. A. coils are as shown in table XIII.

The Wolff manganin coils of the association are also given at 16 degrees C., with a temperature coefficient to be applied for small ranges of temperature only, since it is by no means a linear function.

As has already been explained, the values are given in terms of the laboratory unit which represents 10^9 C. G. S. units of resistance as determined by Lord Rayleigh and Mr. Glazebrook at Cambridge; it has been assumed that the intercomparison of the coils enables that unit to be recovered.

Appendices I and II of the present report afford the means of connecting this unit with those of the Board of Trade, derived from it in 1891, and of the Reichsanstalt, and also with the ohm or international ohm—the resistance, that is, of a certain column of mercury.

RESISTANCE IN LABORATORY (N. P. L.) UNITS OF MERCURY TUBES.

Tube.	Resistance at 0 Degree Centigrade. Potentiometer.	Resistance at 0 Degree Centigrade. Kelvin Double Bridge.	Tube.	Resistance at 0 Degree Centigrade. Potentiometer.	Resistance at 0 Degree Centigrade. Kelvin Double Bridge.
U	0.99913	0.99913	X	1.00007	1.00007
	0.99912	0.99912		1.00006	1.00006
	0.99914	0.99914		1.00007	1.00006
V	1.00041	1.00041	Y	0.99926	0.99926
	1.00044	1.00044		0.99927	0.99926
	1.00040	1.00039_5		0.99925	0.99925
G	1.00034	1.00035	Z	1.00030	1.00030
	1.00036	1.00036		1.00029	1.00029
	1.00035	1.00035		1.00029	1.00029

APPENDIX II—THE RELATION BETWEEN THE INTERNATIONAL OHM (106.300 CM. HG WEIGHING 14.4521 GRAMMES AT 0 DEGREE CENTIGRADE) AND THE UNIT OF RESISTANCE EMPLOYED AT THE N. P. L. PRELIMINARY NOTE.[1]

BY F. E. SMITH.

THE FOLLOWING MEASUREMENTS OF SIX MERCURY TUBES INDICATE THE PROGRESS MADE IN THIS ENQUIRY, AND ALSO THE RELATION OBTAINED.

Tube.	L. Length at 0 Degree Centigrade.	Conical Correction. $\mu \times 10^6$.	Theoretical Length for 1 International Ohm.	a. Calculated Resistance of Tube. International Ohm.	b. Mean Measured Resistance. Laboratory Unit.	b—a.
U	62.0731	5_6	62.1319	0.99905	0.99913	0.00008
V	73.5000	18	73.4759	1.00033	1.00041	0.00008
G	116.507	9	116.478	1.00025	1.00035	0.00010
X	65.6838	2_8	65.7354	0.99997	1.00007	0.00010
Y	62.1867	15	62.2382	0.99917	0.99926	0.00009
Z	68.5199	8	68.5057	1.00021	1.00029	0.00008

APPENDIX III.

B. A.—1.

Date, 1908.	δ	R_1/R_0	Difference of R_1/R_0 from mean.
Feb. 6	1.514	1.38688	—0.00021
" 23	1.505	1.38702	—0.00007
Aug. 7	1.506	1.38708	—0.00001
" 25	1.505	1.38712	+0.00003
" 26	1.514	1.38722	+0.00013
" 31	1.506	1.38722	+0.00013
	Mean 1.5083	1.38709	

Mean value of constants.

R_0	R_1	FI	δ	R_1/R_0
257.905	357.736	99.831	1.5083	1.38709

B. A.—2.

Feb. 12	1.484	1.38867	—6.00014
" 24	1.499	1.38877	—0.00004
" 24	1.495	1.38874	—0.00007
May 19	.....	1.38876	—0.00005
July 30	1.497	1.38880	—0.00001
Aug. 18	1.489	1.38863	—0.00018
" 21	.....	1.38901	+0.00020
" 24	.....	1.38890	+0.00009
" 24	1.493	1.38889	+0.00008
" 26	1.491	1.38892	+0.00011
" 31	1.489	1.38882	+0.00001
	Mean 1.4912	1.38881	

Mean value of constants.

R_0	R_1	FI	δ	R_1/R_0
257.172	357.163	99.991	1.4912	1.38881

[1] From the National Physical Laboratory.

Thus, laboratory unit of resistance = 0.99991 int. ohm.

$$= \frac{106.291}{106.300} \text{ int. ohms.}$$

[The above figures are intended as merely provisional.]

With respect to the measurements of the cross-sections the uniformity of the results shows that an accuracy of 0.001 per cent may be relied upon. Four methods of measuring the resistance will be employed. At present only two of these are completed. The values in each horizontal line refer to different fillings; they are quite concordant, as the values given in the accompanying tables show.

Colorado Electric Light, Power and Railway Association.

The first annual meeting of the Colorado Electric Light, Power and Railway Association was held, October 28 and 29, in the assembly room of the Denver Gas and Electric Company.

The first morning's work began with an executive session, at which the following officers were present: J. F. Vaile, general manager of the Pueblo & Suburban Traction and Light Company, president; William Mayher, president of the Greeley Electric Company, vice-president; George B. Tripp, Colorado Springs Electric Light Company, secretary and treasurer.

Among the state corporations with representatives at the meeting were: Durango Light and Power Company; Larimer Light and Power Company, of Fort Collins; Las Animas Electric Light Company, of Las Animas; Colorado Springs Electric Company; Leadville Gas and Electric Company; Boulder Electric Light and Power Company; Pueblo & Suburban Traction and Light Company; Las Animas Light, Power and Manufacturing Company, of Trinidad; Arkansas Valley Electric Company, of Florence; Gilpin County Light, Heat and Power Company, of Black Hawk; Denver Gas and Electric Company; Denver City Tramway Company; La Junta Electric Company; Greeley Electric Light Company; Crested Butte Water and Power Company; Roaring Fork Electric Light and Power Company, of Aspen; Loveland Light, Heat and Power Company; Lamar Electric Company; La Bella Mili, Water and Power Company, of Goldfield; Colorado Electric Power Company, of Canon City; Colorado Springs & Interurban Railway Company, and Pagosa Springs Electric Light and Power Company.

Among the associate members represented were these: Albert Sechrist Company, Denver; E. C. Means, agent Adams-

B. A.—3.

Feb. 9	1.511	1.38740	+0.00010
" 26	1.511	1.38730	0.00000
Aug. 10	1.509	1.38714	—0.00016
" 18	1.522	1.38732	+0.00002
" 24	1.511	1.38724	—0.00008
" 25	1.515	1.38736	+0.00006
" 26	1.510	1.38731	+0.00001
" 31	1.510	1.38738	+0.00008
	Mean 1.5124	1.38730	

Mean value of constants.

R_0	R_1	FI	δ	R_1/R_0
258.367	358.434	100.069	1.5124	1.38730

B. A.—4.

Feb. 11	1.485	1.38816	—0.00009
" 23	1.499	1.38833	+0.00008
" 26	1.500	1.38826	+0.00001
Aug. 10	1.497	1.38835	+0.00010
" 18	1.473	.....	.....
" 24	1.497	1.38825	+0.00000
" 26	1.494	1.38812	+0.00013
" 31	1.503	1.38826	+0.00001
	Mean 1.4935	1.38825	

Mean value of constants.

R_0	R_1	FI	δ	R_1/R_0
257.627	357.616	99.989	1.4935	1.38825

B. A.—7.

257.749	357.771	100.022	1.506	1.38806
Thermometer electrically heated to 1,400 degrees for two hours :				
270.036	375.213	105.177	1.506	1.38949

APPENDIX IV.

The following table gives the resistance at a temperature of 60° F. (15.55° C.) of a wire of pure annealed copper 1 metre in length, having a mass of 1 gramme, as deduced from the most recent determinations.

In making the reductions, the values for the temperature coefficient and for the density given by the author have been used.

TABLE GIVING RESISTANCE AT 60° F. OF A WIRE OF PURE ANNEALED COPPER, SUCH THAT 1 METRE WEIGHS 1 GRAMME.

Authority.	Source of Copper.	Reference.	Value in Ohm.
Fitzpatrick	Electrolytic	B. A. Report, 1890	0.1475
Swan and Rhodin	Swan's Copper	Proc. R. S , 1894	0.1493
" (second sample)	" "	Proc. R. S., 1894	0.1486
Fleming*	" "	Phil. Mag , 1893	0.1487
Lagarde	Grammont Electrolytic	Hospitalier, 1894	0.1488
		Mean value	0.1486

* In reducing Prof. Fleming's result, the density has been taken as 8.91 grammes per cubic centimetre.

Bagnall Company, Denver; Phelps Company, Detroit; Western Electric Supply Company, of St. Louis; National Carbon Company, Cleveland; Mutual Oil Tank Line, Omaha; W. A. Layman, of the Wagner Electric Company, St. Louis; Westinghouse Electric Manufacturing Company, of Pittsburg; and these of Denver: Gilbert W. Kes & Company; R. J. Cory, of the Allis-Chalmers Company; Thomas H. Smith, American Steel Wire Company, and B. K. Sweeney, B. F. Vreeland, W. J. Otis and George A Wooley.

There were discussions on the subjects of the best methods for lighting cities, for rapid transit, for placing wires underground and for an economic fuel supply, while the following papers were read:

"Hints on Advertising," the Denver Gas and Electric Company; "Fuel Economies," E. E. Summers, of the Denver Gas and Electric Company; "Meters," C. W. Humphrey, of the Denver Gas and Electric Company; and "Single-Phase Motors," by W. A. Layman, of the Wagner Electric Manufacturing Company, St. Louis.

A "question box" provided subjects for impromptu discussion on various topics.

The Canadian Society of Civil Engineers.

The electrical section of the Canadian Society of Civil Engineers held its first meeting on October 15, 1903. The subject for the evening was the electrical equipment of some Canadian hydroelectric power stations. Dr. R. B. Owens, of McGill University, Montreal, president of the electrical section, introduced the subject. In calling this meeting to order, Professor Owens acknowledged the honor which he felt attached to the presidential office, and outlined briefly the efforts to be made to have the meetings for the coming season successful—successful in the sense that some increase of knowledge relating to the profession of the members may come to each one. The membership, he said, was composed of men who had attacked the problem of efficiently utilizing the waste energy of certain Canadian waterfalls, and who had sometimes been compelled to retreat, but who, in every case, had finally led capital to positions of vantage from which have resulted profits and dividends.

At the second meeting it is intended to discuss, as fully as present knowledge permits, the characteristics and consequent spheres of usefulness of alternating-current traction motors. It was needless, Professor Owens said, to emphasize to a Canadian audience the value of devices likely to cheapen the long-distance haulage of material of every kind. No great time is likely to elapse before the necessity of reducing motive power expenditure, and the desire for increased earnings, will require on the part of transportation management a careful consideration of heavy traction electrical methods and when such a time arrives, it becomes members, as electrical engineers, to be ready, both with methods and means. Alternating-current motors promise, better than motors of other types, to meet the demands of steam railway traffic conditions. Hence their consideration is opportune at the present time. Papers on the subject have already been promised from several sources.

The subject for the third meeting, the relative cost of producing power by steam and by water under different conditions, will have a peculiar local interest.

The fourth meeting will be devoted to a consideration of some of the more recent developments in the art of electric illumination; and at the fifth meeting, a return will be made to the consideration of the use of electricity on canals.

At the last meeting of the season, the matter of station design and operation, as affected by the steam turbine, will be discussed.

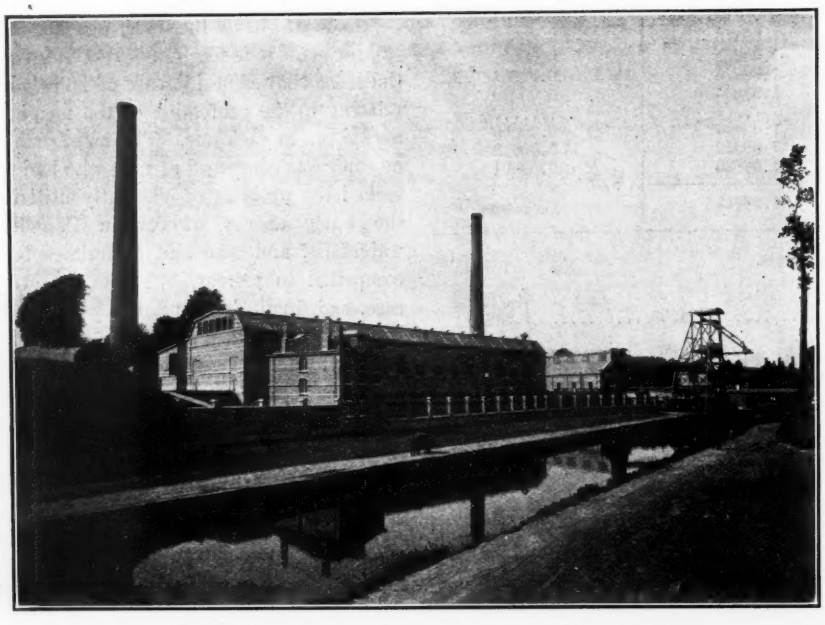
Mr. R. A. Ross is vice-president of the electrical section, and Mr. W. A. Duff is secretary.

The Central Station of the Brussels, Belgium, Tramways.

By Emile Guarini

THE large central station which the Brussels (Belgium) Tramways recently inaugurated, and of which some photographs are here given, taken immediately after the inauguration, presents certain analogies to the central station of the Paris Metropolitan Railway.

The station is situated at Anderlecht, a suburb of Brussels, and replaces the former central stations distributed



THE CENTRAL STATION OF THE BRUSSELS TRAMWAYS.

throughout the city. The latter operate now as substations. All of the electrical apparatus has been furnished and installed by the Union Elektricitäts Gesellschaft, of Berlin. The steam engines were supplied from the shops of Van der Kerkoven, of Ghent. The current produced at the central station is three-phase at 6,600 volts. It is transmitted to three substations which feed, each separately, a particular district. The system is partly trolley and partly conduit, and comprises about eighty kilometres of double-track. The car service is rendered at present by 190 trains, each weighing fifteen tons. At times of heavy traffic there are 295 trains of the same weight.

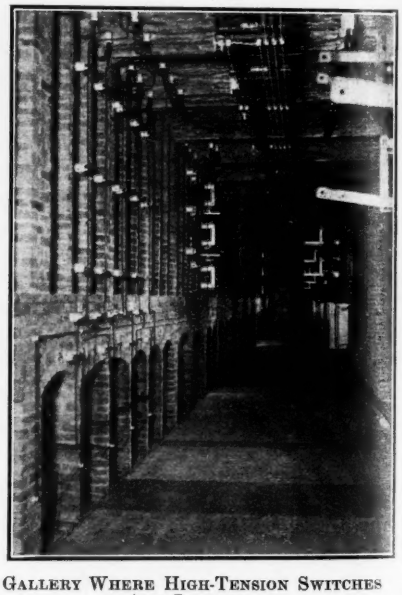
Two of the substations are former central stations. The original distributing cables have also been utilized without change. At each of the three substations the three-phase current is first transformed to the low tension of 410 volts by stationary transformers; then it is converted to continuous current at 550 volts —the tension of the system. Each substation is provided with a battery having an output of sixty ampere-hours at 500 volts, connected in parallel with a starting group. This battery forms a reserve and supplies the lights in the substation.

The engine room contains at present four generating groups of 1,500 kilovolt-amperes. Each group is composed of two engines of the tandem-compound type, with piston valve, rated at 900 to 1,400 effective horse-power, coupled to the same shaft which supports the rotating part of the three-phase alternator. The speed of the engine is ninety-four revolutions per minute. The temperature of the steam at admission is 275 to 300 degrees centigrade. The variations in speed do not exceed one-half per cent for constant load; two per cent for a quick change of load of twenty-five per cent, and six per cent variation for a quick change from no load to full load, or the reverse. The rotor of the dynamo, of which the moment of gyration is 700,000 kilogramme-metres, assures by its mass cyclic regularity of the dynamo, a special flywheel being unnecessary. The steam is expanded from fifteen to six and one-half times its volume at admission. Each group of engines is served by two surface condensers formed of bundles of brass tubes, around the exterior of which passes the condensing water, and through which circulates the steam. The circulating pumps and the air pumps are coupled directly to the crank pin of the engine by means of a connecting rod. This drives also the feed pumps which return the condensed water to the boilers.

The hand wheel of the admission valve, all the valves for the drips, the pressure indicators and speed indicators, etc., are grouped in the rear of the engine. From this point the engineer has complete control of the engines, having at the same time under his eyes all the distributing apparatus, the governor, etc. The governor—there being one for the group of two engines—controls the steam admission of the four cylinders and shuts it off if the load accidentally surpasses a fixed limit.

A small motor controlled from the distributing switchboard allows the counterweight on the engine governor to be displaced easily, so as to vary the speed of rotation and to facilitate in this way synchronizing alternators, which are to be put in parallel.

The four alternators have a normal output of 1,500 kilovolt-amperes at 6,600 volts. At the normal speed, the periodicity is twenty-five cycles per second. These alternators can support an overload



GALLERY WHERE HIGH-TENSION SWITCHES ARE LOCATED.

of fifty per cent for half an hour. The efficiency of the dynamos is ninety-six per cent for a power-factor of unity and at a load of 1,250 kilowatts, including excitation. The exciting groups are three in number, of which two are driven by induction motors supplied at 6,600 volts. The third is driven by a steam engine.

A battery of accumulators serves as a reserve for the exciters, in case of the

stoppage of any of them. The exciting dynamos have eight poles and an output of 100 kilowatts at 110 volts. They run at 230 revolutions per minute. The battery, as well as one of the exciting groups, supplies power for lighting and for auxiliary motors. In order that the exciting circuits may be unaffected by exterior causes, it is kept independent of the motor and lighting circuits, having no common point with them except the negative pole of the dynamo.

The switchboard and apparatus depending on it have been studied with a view of rendering operation as simple and easy as possible. In order to protect absolutely the employés against the dangers of high-tension apparatus, all of it is separated by masonry partitions. All high-tension interrupters are oil break switches controlled from a distance by small low-voltage continuous-current motors.

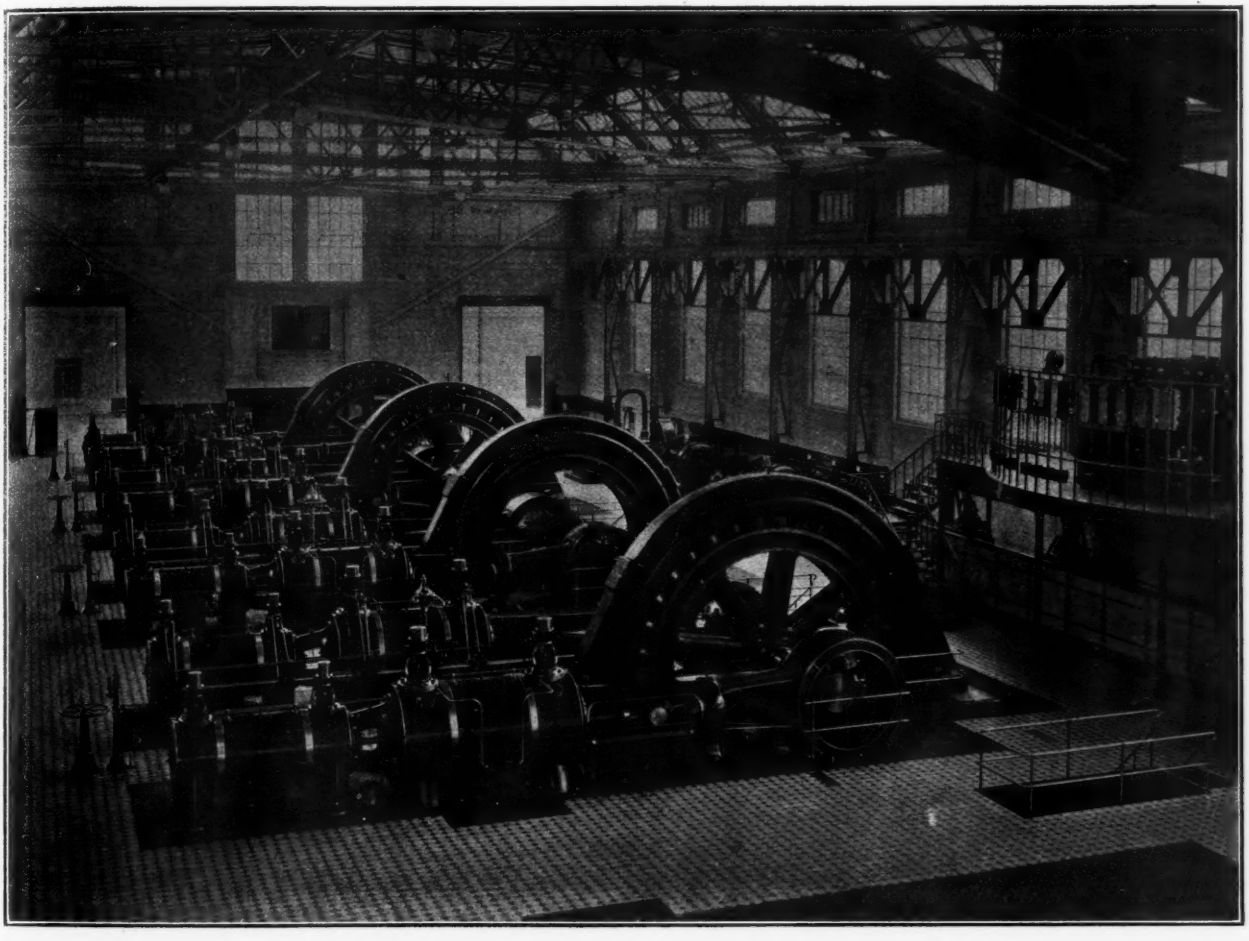
The switchboard proper of the station is placed on a platform, and is divided into three distinct parts. The first contains the low-tension and continuous-current apparatus for excitation, for the batteries, for the station lighting, and for the station motors. The second part of the switchboard includes principally the controlling apparatus for the high-tension interrupters. These are controlled from a distance, the apparatus appearing on the switchboard being only the motor switches for operating the oil break switches, for the three-phase generators, for the feeders going to the substations, for the induction motors driving the exciters, and for the switches which divide the principal bus-bars into sections. An arrangement of indicating lamps shows at all times whether the switches are open or closed. All of this apparatus is arranged on an operating-table placed in the centre of the platform. The third section of the switchboard includes the measuring apparatus for the three-phase generators, for the feeders, and for the motors, and the overload relays for automatically disengaging the oil break switches.

Each feeder, each generating dynamo and each induction motor has its panel where its instruments are assembled. All of these are low-tension instruments. The feeder panels include an ammeter for each phase. The generator panels are supplied with a phase meter, an ammeter, a voltmeter and a wattmeter. The induction motor panels are supplied with an ammeter and a voltmeter. In the middle of the table are placed a Lincoln synchronoscope and synchronizing lamps. In addition there is, corresponding to each induction motor, an automatic overload relay controlling an oil break switch. These relays are separated from the secondary circuit by small current transformers, and are fixed to the lower part of the switch columns.

All the high-tension apparatus is placed in the basement. A 550-ampere-hour accumulator is also in the basement of the coal house. This battery serves for lighting at night and as a reserve for the exciters.

The oil break switches are of recent pattern, and were designed by the General Electric Company, of Schenectady, N. Y.

The boiler room contains ten Babcock & Wilcox boilers with 350 square metres of heating surface and six and one-half of grate surface. These are arranged in five groups of two each. One of the groups is equipped with Babcock & Wil-



Interior of Central Station, Showing Engines and Generators and Switchboard.

cox revolving grate stokers. Each of the five groups is furnished with a reheater and a Green fuel economizer. The latter consists of iron pipes placed in the smoke flues, and the feed water circulating through the pipes. The cleaning scrapers surrounding the tubes are raised and lowered by a small electric motor.

The boilers are fed normally by means of pumps connected directly to the cranks of the engines. As a reserve to these pumps, two steam pumps and one electric pump have been provided, the latter serving also to supply the water necessary for cleaning the tubes by means of a revolving scraper.

Each of the boilers is furnished with a superheater of about eighty square metres heating surface. This is composed of four transverse boxes, two above and two below, and connected by 144 steel tubes with an exterior diameter of thirty-eight millimetres.

The principal piping for the superheated steam is of weldless steel. A group of valves allows any section of pipe or any engine or boiler to be cut out without interfering with the other. The expansion of this pipe is taken up by two packed sleeves.

The coal-handling apparatus takes the coal directly from the boats or wagons and delivers it to the coal storage, delivers it before each boiler, and removes the ashes from the furnaces. It is driven by a continuous-current electric motor.

The Brussels Tramways, as has been said before, possess at the present time three substations placed in convenient localities for the city and the suburb. These three substations contain synchronous converters each, and do not differ materially from one another. The converters are six-pole machines, 410 volts on the alternating side and 550 volts on the continuous-current side. The output of these units is 550 kilowatts. Each converter has its three stationary transformers of 200 kilowatts each, which reduce the primary voltage from 6,600 volts to 410 volts. The end of each secondary is connected at two points of the armature diagrammatically opposite. The efficiency of the converters has been found to be about ninety-four per cent, at a power-factor of unity. They can support an overload of fifty per cent for a half hour, and are compound-wound.

The stationary transformers are air-cooled. Their efficiency is ninety-eight per cent, with a power-factor of unity, and they can stand the same overload as the converters.

The converters are normally started from the continuous-current side, and there is at each substation a starting group composed of an induction motor for 6,600 volts, driving a continuous-current dynamo of seventy-five kilowatts, 550 volts.

The design of the station was made toward the beginning of 1901. Work was started in September of the same year. The installation was completed in June, 1903. In its equipment the latest advances in electrotechnics have been followed.

MEASURING INSTRUMENTS AND SWITCHBOARD GALLERY. BOILER ROOM, BRUSSELS CENTRAL STATION.
INTERIOR OF ONE OF THE SUBSTATIONS, SHOWING CONVERTERS AND STATIC TRANSFORMERS. HIGH-TENSION CIRCUIT-BREAKERS.

The following are a few details in regard to the Brussels Tramways: The personnel has been increased at the present time to 2,000 men. The number of cars is 500. Electric traction enjoys such favor with the Brussels public that the road has carried during the year 1903 70,000,000 passengers, an enormous figure for a city as small as Brussels, which, without suburbs, does not possess more than 150,000 inhabitants. This is the more remarkable since the number of 70,000,000 does not include the numerous passengers who patronized the steam tramways, the suburban lines and the omnibuses.

SHOP TESTING OF MOTORS AND GENERATORS FOR COMMERCIAL SERVICE—VI.

BY BERTRAND B. ABRY.

5—THE ALTERNATING-CURRENT GENERATOR.

We wish to consider here the usual factory tests made on an alternating-current generator. They are as follows:

1. Determination of polarity.
2. Measurement of resistance.
3. Iron loss and saturation test.
4. Short-circuit test.
5. Electromotive-force regulation test.
6. Temperature test.
7. Insulation test.

1. Determination of Polarity—In prefacing these articles on shop testing attention was called to the tests in general on electrical machinery. It was pointed out that the tests determine, first, the electrical performance of the machine, and second, the mechanical construction and

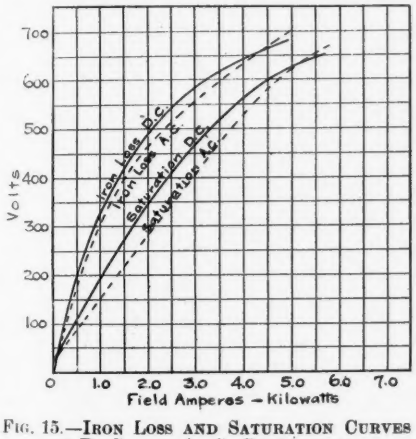


FIG. 15.—IRON LOSS AND SATURATION CURVES OF D. C. AND A. C. GENERATORS.

workmanship. It is for the purpose of detecting faults in the workmanship and in the assembly of the machine, and particularly in the field connections, that the test for the determination of polarity is made. More especially in the case of generators having a great number of poles are mistakes likely to occur in properly placing and connecting the field coils. The quickest method of detecting whether alternate poles are north and south is by the use of a compass or a simple steel needle suspended from its centre point by means of a thread. Such an instrument can very readily be made from a short piece of steel wire, and gives possibly better and more positive results than the small magnetic compass, the polarity of each pole being quickly determined by passing the needle before it.

2. Measurement of Resistance—As in the case of direct-current machines, the resistance of the field and armature of an alternating-current generator is measured by the fall of potential method, employing direct current. If, for example, the machine is a revolving field three-phase generator, we may first measure the cold resistance of the field, being careful in all cases not to use so great a current as will unduly heat the windings and increase the resistance during the observations, which may be recorded as follows, noting also the air temperature:

FIELD RESISTANCE AT TWENTY-SIX DEGREES CENTIGRADE.

Volts.	Amperes.
63.5	73.6
59.0	68.0
49.0	56.4

Usually if the drop and current are measured accurately it is not necessary to take more than three or four sets of readings from which to obtain the average resistance, but in order to eliminate as far as possible any error which may occur in reading the instruments, it is advisable to take at least three sets of observations. The number of the instrument and the scale used, whether high or low, should be noted in all cases, so that proper corrections can be made for the calibration, as explained earlier. In the case of the armature, the resistance of each phase is determined as follows:

In the case of a three-phase machine the voltage across each phase is measured and recorded. These voltages should be exactly the same. The iron loss in watts is calculated from this data obtained during the test in the same manner as with a similar test on direct-current machines.

In Fig. 15 typical iron loss and saturation curves of corresponding direct and

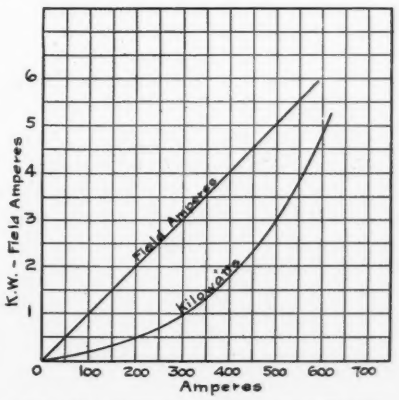


FIG. 16.—CURVES PLOTTED FROM SHORT-CIRCUIT TEST.

alternating-current generators are shown. It will be seen that the iron loss curves in both cases are somewhat similar, but we wish to call attention especially to the difference in the saturation curves of the two machines. As compared with the saturation curve of the direct-current generator, the saturation of the alternating-current machine is practically a straight line. That is, the iron is purposely worked at a lower induction in the case of the alternator. With direct-current machines proper regulation is secured on heavy loads by the automatic strengthening of the field. Alternating-current machines are, as usually designed, provided with a large number of poles. The proximity of the poles to each other gives rise to a greater magnetic leakage than in the case of direct-current machines. Excessive magnetic leakage would mean poor regulation on inductive loads.

ARMATURE RESISTANCE AT TWENTY-SIX DEGREES CENTIGRADE.

1-2.		1-3.		2-3.	
Volts.	Amperes.	Volts.	Amperes.	Volts.	Amperes.
111.0	34.4	103.0	32.3	102.6	32.1
86.0	26.6	96.8	30.3	97.0	30.4
80.8	24.6	92.2	28.8	92.0	28.8

Knowing the current and drop in each case, the resistance may be calculated for any number of observations and the average resistance obtained therefrom. Finally these resistances may be reduced to twenty-five degrees centigrade as explained heretofore.

3. Iron Loss and Saturation Test—The method of making an iron loss and saturation test on an alternating-current generator is very similar to the test on a direct-current machine. The generator is belt-connected to a shunt motor arranged to drive it at a constant speed. The following observations are made during the test:

Motor.			Generator.				
Volts.	Amperes.	Field Amperes.	Speed.	A. C. Volts.			Field Amperes.
				1-2.	1-3.	2-3.	

The alternator is usually designed then to run at a lower saturation under normal conditions so that this leakage will not defeat the effort to maintain normal voltage on such inductive loads. Hence the results of such a test when plotted should give very nearly a straight line saturation curve.

4. Short-Circuit Test—This test is usually made just after the iron loss and saturation have been determined. The same wiring and connections used in the iron loss test are employed, and the generator, with armature short-circuited, is driven at a constant speed by the shunt motor. After properly adjusting the motor field to give the correct generator speed, the first observations are made with zero generator field charge.

After the first set of readings is taken, a second set of observations is made with a generator field charge sufficient to give a dead short-circuit current through the armature equal to one-half the normal current output of the machine. Generally three sets of observations are all that is necessary to give the results desired. A final reading is taken with a field charge sufficient to give full load short-circuit current. The figures in the table above are only approximate and given merely for the purpose of showing the convenient method of recording observations.

Motor.			Generator.				
Volts.	Amperes.	Field Amperes.	Speed.	Amperes.			Field Amperes.
				Phases			
				A	B	C	
110	60	5.2	510	0	0	0	0
110	125	5.15	511	185	183	183	3.8
110	162	5.11	510	375	374	373	8.1

Having obtained these results we may plot a curve which will give at once the copper loss in the machine for any current output. The copper loss for two points on this curve is equivalent to the difference between the product of the motor volts and amperes with zero generator field current, and product of the motor volts and amperes for the two conditions as noted. This difference is plotted in watts or kilowatts. Fig. 16 shows this curve and the field ampere curve plotted with short-circuit amperes as a base and watts and field amperes as ordinates.

It will be seen from the curve that the copper loss increases very gradually at first, but on heavy loads the rate of increase is very rapid. This rapid increase in the copper loss accounts to considerable extent for the decreasing efficiency at these loads.

5. Electromotive-Force Regulation Test—By electromotive-force regulation of an alternating-current generator is meant the increase in per cent of the terminal voltage which results when the load is thrown off, the speed and field current remaining the same.

Alternating-current regulation tests on composite machines are usually made to determine what is known as (1) constant potential regulation, and (2) commercial regulation with maximum compounding.

In making such tests the generator is belt-connected to a motor arranged to drive it at constant speed. The wiring and connections for the motor are similar to those which were shown in Fig. 4 in the article on direct-current generator tests.

In making a constant potential regulation test the separate field is excited to give normal voltage on no load and this field current kept constant. The following observations are noted:

The test is begun at zero load and increased gradually up to about twenty-five per cent overload. If the machine is a three-phase generator, for example, the current in each phase is recorded as well as the electromotive force across each phase. With generators of this kind it is necessary to adjust the compensator by hand in order to secure constant potential regulation. Therefore during this test note also the different compensator amperes and volts to give constant potential with each change in load. The regulation curve is plotted as shown in Fig. 17 together with the separate field amperes, and the compensator amperes and voltage curves.

Generator.					
Speed.	Amperes.	Volts.	Field Amperes.	Compensator.	
				Volts.	Amperes.

A commercial regulation test on an alternating-current compound-wound generator is usually a three-point regulation—zero, one-half and full load—with the compensator so adjusted as to give maximum compounding. The test is carried out in this way: with the generator running under the same conditions of speed and excitation as above noted, but with normal load, the compensator brushes are shifted until the maximum generator voltage is secured. When this point has been determined the brushes are left in that position throughout the test. After adjusting the compensator the generator load is reduced to zero and the first set of readings taken. Then increase the load to one-half full load, and finally full load, making a second and third set of observations respectively. Fig. 18 shows the curves plotted for the commercial regulation test. Constant potential regulation tests are made with a non-inductive load. A commercial regulation test with maximum compounding is usually made with a non-inductive load also, but very often it is desired that such a test be made with an inductive load of a certain per cent power-factor. If such be the case, the compensator is first adjusted to give maximum compounding. Such a load is obtained by the use of a rack and choke coils in parallel. If, for instance, it is desired to make a regulation test with an eighty-five per cent power-factor, the non-inductive and inductive loads are adjusted to give approximately this percentage. A wattmeter reading is then taken of the true kilowatt output, and the current and voltage measured to give the apparent kilowatts with the machine running at normal load. The ratio of the true kilowatts to the apparent kilowatts gives of course the power-factor. If we find in this way that the power-factor is too high, then the rack load should be decreased and more choke coils added until the desired ratio is obtained, and *vice versa* if the power-factor is too low. Fig. 19 shows the curves plotted from a test with inductive load.

In the case of those generators built with a separate field winding only, it is necessary to vary the field current by means of a rheostat in order to secure the desired regulation. However, we have not considered such a generator in particular, because almost all standard machines are built with compensator windings.

6. Temperature Tests—As in the case of direct-current machines, temperature

tests on alternators are made to determine the temperature rise above the surrounding air after running at some specified load for a given time. This temperature rise bears a close relation to the rating

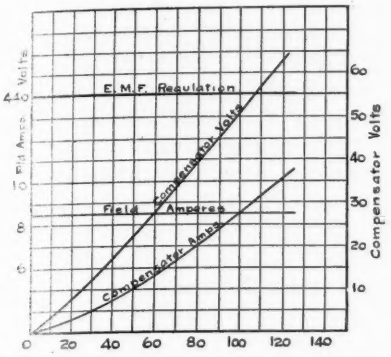


FIG. 17.—CONSTANT POTENTIAL REGULATION—RACK LOAD.

of the machine. On the smaller size alternators it is perfectly feasible to make a temperature test at normal load or some specified overload under usual operating conditions, in much the same manner as with the direct-current generator. But with the larger size generators running up to several hundred kilowatts capacity, facilities are not always at hand for taking care of such a load. If such a generator be a separately excited machine, the usual temperature test made is with a slightly higher field current than normal, with the armature open-circuited, and is in reality a field temperature test. During such a run, the speed, field current and field drop are observed every hour, and at the conclusion of the run thermometer readings are taken also. The test is continued under the above conditions until the field drop is practically

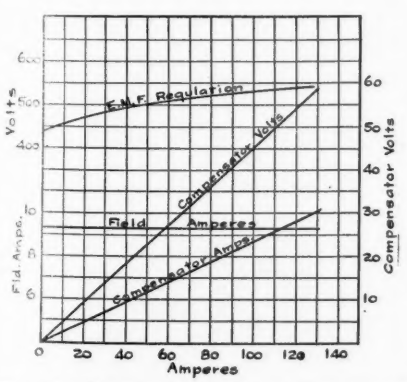


FIG. 18.—ELECTROMOTIVE-FORCE REGULATION WITH MAXIMUM COMPOUNDING—RACK LOAD.

constant, and may vary in length from eight to ten or twelve hours. The field is excited with a field current a little greater than normal in order to provide approximately the same conditions during the temperature run as would obtain under full load operating conditions with armature reaction present.

If the generator be a composite machine, such a temperature test is made with normal field excitation and the compensator open-circuited, it being assumed that the compensator current will offset the armature reaction when operating under normal conditions.

7. Insulation Test—Standard insulation tests on alternating-current generators are usually made between windings and ground at an alternating potential of approximately twice the rated voltage of the machine for those generators designed to run at 2,200 volts or over. For lower voltages than this, the insulation test may be at a potential as high as four times the rated voltage of the generator. There is a general tendency among manufacturers and engineers to adopt the American Institute standard in-

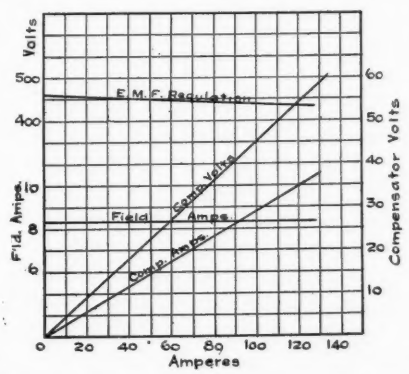


FIG. 19.—ELECTROMOTIVE-FORCE REGULATION WITH MAXIMUM COMPOUNDING—POWER-FACTOR LOAD.

sulation test of twice the rated voltage for one minute.

Wireless Telegraphy in China.

It is reported that the Italian legation at Pekin has installed a wireless telegraph station which will enable it to maintain communication with the Italian ships stationed at Taku, Tien-Tsin and on the coast. The first messages to be sent from the station were to the admiral's vessel, Vettor Pisani, in the Gulf of Pechili, 130 miles distant.

Rapid-Cutting Steel.

A joint committee, consisting of members of the council of the Manchester Association of Engineers, of Manchester, England, and of members of the Manchester School of Technology subcommittee, together with Dr. J. T. Nicolson, professor of mechanical engineering at the school, have just completed a long series of experiments, the purpose of which was to test the capabilities of some of the high-speed tool steels that have recently been introduced. The report of the committee embodying the results of the tests was presented at the meeting of the Manchester Association on October 24. The following abstract is from the *Electrical Engineer,* of London. In carrying out the experiments, a large lathe capable of carrying a steel forging of three tons weight was driven through countershafts by a 100-horse-power electric motor. The power was measured by the use of carefully calibrated volt and amperemeters, and the net horse-power used in cutting was ascertained by the aid of a powerful transmission dynamometer and a large Prony brake. In addition, the actual force exerted upon the tool when cutting was measured by a lathe tool dynamometer having a capacity up to fifteen tons fitted to the lathe. Cuts up to three-eighths inch by three-eighths inch were taken with the tool fixed in this dynamometer, the load being read off in the simplest way by means of a standard pressure gauge. It appeared from the trials that speeds of from 110 to 150 feet per minute were possible for soft steel, 80 to 110 feet for steel of medium hardness, and forty to fifty feet for hard steel. In the case of cast iron, speeds of 100 to 110 feet for soft, fifty to sixty feet for medium, and thirty to forty feet for hard were obtained. It was also found that forty-five square feet may be machined over in an hour by these rapid-cutting steels when operating upon soft steel with a cut three-sixteenths inch deep, the figures for medium and hard steel being thirty and eighteen respectively. With cast iron a surface of forty-two, eighteen and fifteen square feet may be turned off at the same cut in the case of the soft, medium and hard varieties respectively. But few specially heavy cuts were attempted, but it was found possible (when taking a cut three-eighths inch deep by one-eighth inch traverse) to remove 440, 330 and 180 pounds of cuttings per hour from the soft, medium and hard steel forgings respectively, and 450, 200 and 190 pounds from the soft, medium and hard cast-iron specimens. In one instance, with a three-eighths inch by three-eighths inch cut, cuttings were removed at the rate of 510 pounds per hour from soft-steel bar. The tests further showed that the forces acting upon the tool point when cutting were over 100 tons per square inch of area of section of cut in steel, and from fifty to eighty tons per square inch for cast iron. One of the most noteworthy facts discovered is that the cutting force does not increase, but appears rather to diminish, with increasing speeds. This is

contrary to the opinion generally held by turners and machine tool experts, as instanced by the objections raised by workmen to an increase of the cutting speed on account of the anticipated springing of the work. This objection can no longer be sustained, for although higher speeds of taking a given cut will, of course, require a greater driving power almost in direct proportion to the increased speed, no greater but rather a smaller force will be brought upon the tool, and the load acting on belts and gearing, and the tendency of the lathe and work to spring, will be rather diminished than otherwise. On the other hand, it has been conclusively shown by these trials that heavy cuts at moderately high speeds are much more economical in power than light cuts at the highest possible speeds the tool can stand. For the cutting speed does not increase as fast as the area of the cut diminishes, so that more material can be machined off in a given time with a heavy cut than with a light cut at its corresponding faster speed. Further, the total or gross horse-power required for cutting consists of the sum of that lost by friction of the intermediate gearing and of the lathe, as well as the effective work spent upon cutting. Now, the frictional power does not vary much, whether there is a heavy or a light cut on the machine; it therefore forms a much larger percentage of the whole at light cuts than at heavy cuts. The value of the report is enhanced by the exhaustive tests of the physical and mechanical properties and the chemical constituents of the six different materials operated upon—namely, forged steel and cast iron, each of three grades of hardness.

The International Electrical Congress of September 12 to 17, 1904, at St. Louis.

We are informed that the following appointments have been made by Professor Elihu Thomson, president of the Committee of Organization of the St. Louis International Electrical Congress, for the officers of the various sections:

GENERAL THEORY.

Section A—Mathematical, experimental. Professor E. L. Nichols, chairman, Cornell University; Professor H. T. Barnes, secretary, McGill University.

APPLICATIONS.

Section B—General Applications. Dr. C. P. Steinmetz, chairman, Schenectady, N. Y.; Professor Samuel Sheldon, secretary, Polytechnic Institute, Brooklyn.

Section C—Electrochemistry. Professor H. S. Carhart, chairman, University of Michigan; Mr. Carl Hering, secretary, Philadelphia.

Section D—Electric power transmission. Mr. Charles F. Scott, chairman, Pittsburg; Dr. Louis Bell, secretary, Boston.

Section E—Electric light and distribution. Mr. J. W. Lieb, Jr., chairman, New York; Mr. Gano S. Dunn, secretary, Ampere, N. J.

Section F—Electric transportation. Dr. Louis Duncan, chairman, Massachusetts Institute of Technology; Mr. A. H. Armstrong, secretary, Schenectady.

Section G—Electric communication. Mr. F. W. Jones, chairman, New York; Mr. A. B. Gherardi, Jr., secretary, New York.

Section H—Electrotherapeutics. Dr. W. J. Morton, chairman, New York; Mr. W. J. Jenks, secretary, New York.

It is understood that all of these gentlemen, who are well-known specialists in the departments they represent, have already accepted these appointments, with the exception of one who has been yet unable to do so, owing to absence in Europe, but who is now returning.

The section officers will have charge of the proceedings of the congress at St. Louis in their respective sections.

The papers that are to be read at the congress will be communicated by invitation from well-known authors in this country and abroad. They are to be read and discussed at St. Louis during the congress week, September 12 to 17, 1904. They are then to be printed and published in book form.

Invitations to join the congress are steadily being issued to persons and parties interested in electricity. Over 6,000 such circular letters of invitation will be sent out in the United States, and a similar number to foreign countries. Most of the circulars are being directed to members of electrical industries, societies and scientific institutions. Joining the congress will entitle the members to attend the various functions at St. Louis and also to receive a copy of the subsequent transactions. It is expected that many will join the congress who can not expect to attend the sessions in St. Louis, merely to receive the subsequently printed transactions. The transactions are expected to form a very valuable addition to electrical literature, both theoretical and practical. Already about 350 Americans have joined the congress in response to circulars, and only part of the circular catalogue has been covered. There is, consequently, every reason to expect a large and representative membership in the congress, both from this country and abroad.

Communications concerning the congress should be addressed to the general secretary, Dr. A. E. Kennelly, Cambridge, Mass.

Memorial to Dr. Robert H. Thurston.

It has been proposed by President Schurman, of Cornell University, that the old students, alumni and friends of Sibley College and of the University undertake the erection of a new laboratory for Sibley College, as a memorial to the late Dr. Robert H. Thurston, and that the building be called Thurston Hall.

Notes on Electrical Engineering.

In connection with the instruction of non-electrical engineers in fundamental features of electrical applications and engineering at Sibley College, Cornell University, it has been found desirable to prepare an outline of a course of sixty lectures. The more elementary parts of this have been necessarily amplified into almost text-book form. These notes have been printed, in order to issue them to the large classes requiring them, to which they are supplied at cost price. It has occurred to the authors, Professors Harris J. Ryan and Henry H. Norris, that other institutions might find these notes useful, and they will be glad to furnish them to such as desire them, practically at cost. Those interested should address Professor Henry H. Norris, Sibley College, Cornell University, Ithaca, N. Y.

Wireless Telegraph Tests.

On October 24 Mr. William Marconi sailed from Portsmouth, England, on the battleship Duncan, for the Mediterranean, where he intends to carry out further experiments on wireless telegraphy. During the voyage he will attempt to establish communication with Gibraltar before he loses communication with the British ship, Hector, which will remain stationed off Portsmouth. It is said that the apparatus installed on the Duncan differs in some essentials from the standard instruments with which most of the men-of-war are equipped. Captain Jackson, who commands the Duncan, is an authority on wireless telegraphy, having recently served a commission in the Vulcan on the Mediterranean station, a vessel to which he was appointed to enable him to pursue his experiments. The Duncan took out a large quantity of wireless telegraph apparatus for distribution among the British Mediterranean fleet.

THE CONDITIONS GOVERNING THE RISE OF TEMPERATURE OF ELECTRIC RAILWAY MOTORS IN SERVICE.

(Concluded.)

BY CARY T. HUTCHINSON.

The ratio of average to maximum core loss depends on the variation of core loss with speed and current; to fix this variation, the individual core loss curves of a number of motors were plotted, and a curve determined showing the average variation of the core loss. Curve-sheet 9 shows the curve of the average variation of core loss used in this investigation; the values from this curve were plotted on the various velocity time-sheets and integrated; this gives the core loss during acceleration on the motor curve. In addition to this, core loss curves of several motors, differing widely, were selected, and the ratios of average to maximum for different operating conditions were determined. These ratios were found to differ comparatively little for the different curves—much less than the actual values of the core losses differ. The average core loss during the period of acceleration on resistance was taken at forty-two per cent of the maximum core loss. This value was obtained from a number of separate core loss curves.

The average percentage heat loss during acceleration to the same maximum velocity for any motor is practically independent of the initial acceleration; the ratio of average to maximum copper loss increases with the acceleration, while the ratio for the core loss decreases.

The variation of the loss with initial acceleration in two typical cases is given in the tables following:

TABLE I.

Average heat loss, for velocity of 150.
Copper loss at rated load = 3 per cent
Core " " " " = 3 "

Initial Acceleration.	Average Loss.
1 mph/sec.	3.88 per cent
1.5 "	3.91 "
2 "	3.91 "
2.5 "	3.91 "

TABLE II.

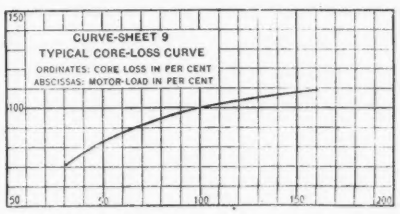
Average heat loss, for velocity of 150.
Copper loss at rated load = 7 per cent
Core " " " " = 1 "

Initial Acceleration.	Average Loss.
1 mph/sec.	4.77 per cent
1.5 "	4.92 "
2 "	5 "
2.5 "	5.03 "

For velocities greater than 150, the variation is greater; for lower velocities, it is less. The values for $(a) = 1.5$ are used.

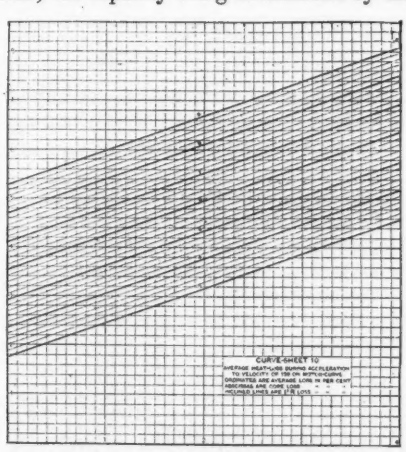
Although this approximation is satisfactory for the purpose, yet if greater accuracy is desired, it is possible to plot the average loss for the various initial accelerations separately; but the complication is very much increased.

Curve-sheet 10 gives the average percentage heat loss during acceleration for any combination of copper and core losses within the range covered, for a velocity of 150 on the motor curve. The ordinates are average loss, the abscissæ core loss, and the inclined lines copper loss; for in-



CURVE-SHEET 9.

stance, for a four per cent copper loss and 2.5 per cent core loss, the intersection of the vertical at 2.5 with the inclined line marked four, gives the average loss of 4.12 per cent, and this this will be the average loss occurring in a motor accelerating by series parallel, and then on the motor curve to a velocity fifty per cent greater than the velocity when resistance is cut out, the motor having a four per cent copper and 2.5 per cent core loss; the capacity being determined by the



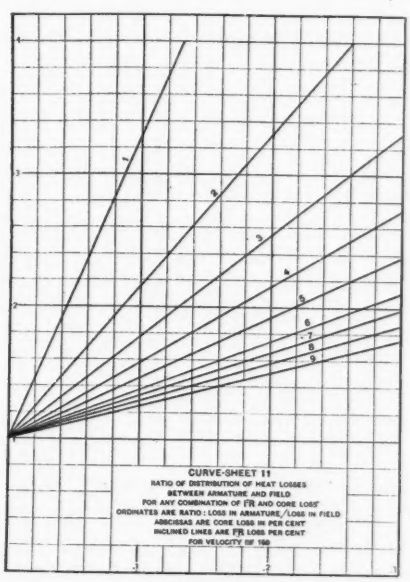
CURVE-SHEET 10.

product of the torque during initial acceleration and the velocity with resistance out, that is the maximum power input.

The ratio of distribution is practically independent of the initial acceleration for a given maximum velocity, and for the range of initial acceleration used, *i. e.*, from $(a) = 1$ to $(a) = 3$. While this is not strictly correct, yet the difference between the values calculated accurately and the values found by assuming an average ratio of mean to maximum copper and mean to maximum core loss, does not exceed five per cent for the range covered; since this ratio is used only to fix the appropriate value of the radiation constant (of which the determination is in itself necessarily rough) the degree of accuracy is sufficient.

Curve-sheet 11 gives, for a velocity of 150, the ratio of distribution as ordinates, with core loss as abscissæ, and with inclined lines for the various copper losses; for instance, with copper loss of four per cent and core loss of 2.5 per cent, the ratio of distribution is 2.44. It is assumed that the copper loss is half in armature and half in field.

These curves then determine the average loss during acceleration and its dis-



CURVE-SHEET 11.

tribution; to get the average loss during the run the ratio of time of acceleration to time of run must be known.

Referring to Fig. 3,

$$RH/OR = AD/OD$$

i. e.,

$$(100 + a\,t_2)/Y_t = (t_1 + t_2)/x$$

and

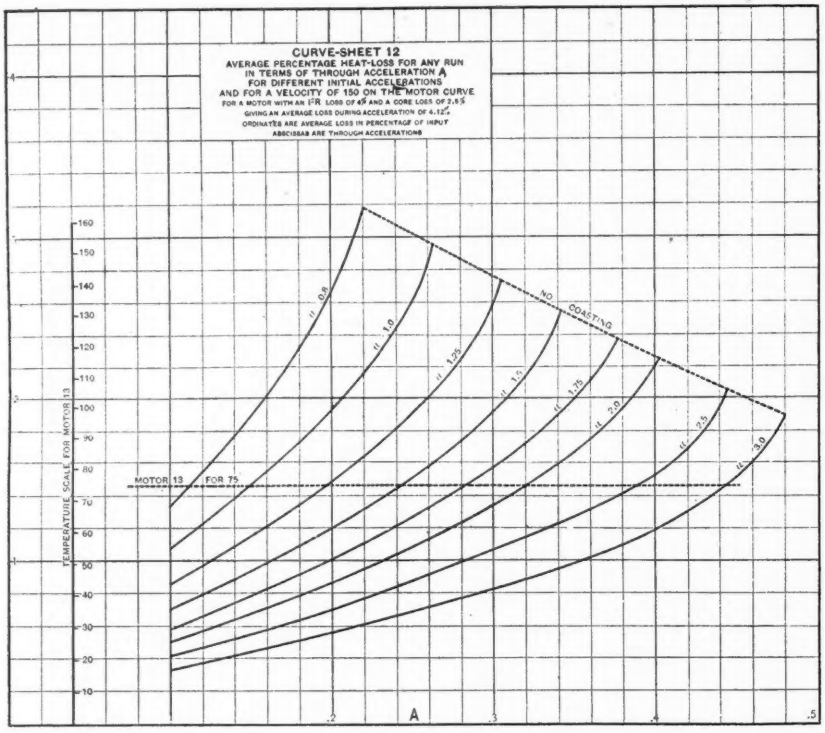
$(100 + a\,t_2)/Y_t \times x/T = (t_1 + t_2)/T =$ time of acceleration divided by total time.

x/T is taken from curve-sheet 1 for the various values of A and (a), thus the ratio of the times is determined for all conditions the corrections to the type curve must be allowed for.

Curve-sheet 12 has been prepared in this way—it gives the average percentage loss during the run, for various initial and through accelerations, for a motor having a copper loss of four per cent, a core loss of 2.5 per cent, and consequently an average loss during acceleration to a velocity of 150, of 4.12 per cent. The ordinates are average losses in percentage

of maximum input; the abscissæ are through accelerations and the separate curves are for the different initial accelerations.

The average loss during any particular run is equal to the average loss during acceleration multiplied by the ratio of the


CURVE-SHEET 12
AVERAGE PERCENTAGE HEAT-LOSS FOR ANY RUN IN TERMS OF THROUGH ACCELERATION A FOR DIFFERENT INITIAL ACCELERATIONS AND FOR A VELOCITY OF 150 ON THE MOTOR CURVE
FOR A MOTOR WITH AN I²R LOSS OF 4% AND A CORE LOSS OF 2.6%
GIVING AN AVERAGE LOSS DURING ACCELERATION OF 4.12%
ORDINATES ARE AVERAGE LOSS IN PERCENTAGE OF INPUT
ABSCISSAS ARE THROUGH ACCELERATIONS
TEMPERATURE SCALE FOR MOTOR 13
MOTOR 13 FOR 75
NO COASTING
a = 0.8
a = 1.0
a = 1.25
a = 1.5
a = 1.75
a = 2.0
a = 2.5
a = 3.0
A

Curve-Sheet 12.

times, and since this ratio is independent of the losses in the motor, it is obvious that curve-sheet 12 will represent the average loss during that run for any motor, if the ordinates are varied in proportion to the average losses during acceleration. Curve-sheet 10 gives the average losses during acceleration; hence these two sheets will determine the average losses for any motor for any run, accelerating to a velocity of 150 on the motor curve. For example, a motor with a nine per cent copper and two per cent core loss has an average loss during acceleration of 6.7 per cent; curve-sheet 12 is plotted for an average loss of 4.12 per cent, hence if its ordinates be multiplied by $6.7/4.12 = 1.63$ it will give average loss for the second motor.

For example,

For $(a) = 1.25$ mph/sec.
and $A = 0.2$ "
Average loss = 1.48 per cent (curve-sheet 12)

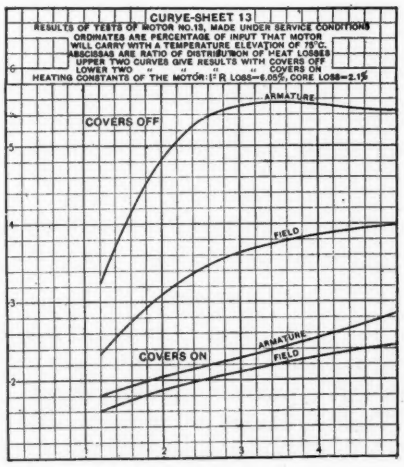
and therefore

1.63×1.48 per cent = 2.41 per cent.

is the average loss of the second motor for the same run. Similarly for other combinations of copper and core loss.

These curve-sheets determine the average heat loss of any motor for any run, and its ratio of distribution; it remains then to connect these calculated values with results of test made under comparable conditions of service, giving the temperature rise for various losses, *i. e.*, with the radiation coefficient of the motor under consideration.

Many tests of this nature have been made by the General Electric Company on its experimental track at Schenectady,


CURVE-SHEET 13
RESULTS OF TESTS OF MOTOR NO. 13, MADE UNDER SERVICE CONDITIONS
ORDINATES ARE PERCENTAGE OF INPUT THAT MOTOR WILL CARRY WITH A TEMPERATURE ELEVATION OF 75°C.
ABSCISSAS ARE RATIO OF DISTRIBUTION OF HEAT LOSSES
UPPER TWO CURVES GIVE RESULTS WITH COVERS OFF
LOWER TWO " " " COVERS ON
HEATING CONSTANTS OF THE MOTOR: I²R LOSS=6.05%, CORE LOSS=2.1%
ARMATURE
COVERS OFF
FIELD
ARMATURE
COVERS ON
FIELD

Curve-Sheet 13.

by running trains back and forth over the track until permanent conditions of temperature have been attained, and at the same time, measuring the losses in the motors.

Curve-sheet 13 gives such test results for a motor in general use; the ordinates give the average loss in percentage of input that the motor will carry with a rise of temperature of seventy-five degrees centigrade under the conditions of service determined by the ratios of distribution denoted by the abscissæ; these curves are calculated from test results which give the rise of temperature per watt lost for field and armature separately; the curves are given for tests made with covers on the motors and covers removed. Thus curve-sheet 13 shows that for a ratio of distribution of two, the armature of motor No. 13 will carry, with covers off, a load giving a loss of 4.82 per cent, whereas the fields will stand only 3.1 per cent; but if this motor be used with covers on, then at the same ratio the armature will stand a load giving a 2.05 per cent, and the fields a 1.88 per cent loss—very nearly the same, as should be.

These test results are used as follows:

Motor No. 13 has

Copper loss = 6.05 per cent
Core " = 2.10 "

Then

Average loss during acceleration to velocity 150 = 5.06 per cent (curve-sheet 10)

Ratio of distribution of losses = 1.77 per cent (curve-sheet 11)

At this ratio of distribution, the permissible loss, with covers on, is

Armature, 1.98 per cent (curve-sheet 13)
Field, 1.80 " (curve-sheet 13)

Hence the field controls, and the motor can carry only a load giving a loss of 1.8 per cent; the armature will then run much cooler than seventy-five degrees; in fact, at $1.8/1.98 \times 75° = 68°$ centigrade.

Curve-sheet 12 is plotted for an average loss of 4.12 per cent, hence to apply it to motor No. 13, the ordinates should be increased in the ratio of $5.06/4.12 = 1.23$: if this were done and a horizontal section of curve-sheet 12 were taken with the 1.8 per cent line for ordinate, the initial accelerations would be determined, for each through acceleration, that would result in a loss of just 1.8 per cent and consequently in the exact temperature rise permitted; but the same numerical results will be obtained by taking a cross-section of curve-sheet 9 at the ordinate 1.8 per cent $/1.23 = 1.46$ per cent.

The dotted line marked "motor No. 13" shows this cross-section.

The values of (a), the initial acceleration, as determined by this cross-section, are plotted on curve-sheet 14 in terms of A as abscissa; the corresponding values of energy per ton-mile and of horse-power

per ton for velocity of 150 are taken from curve-sheet 3 and 4. Thus, curve-sheet 14 gives the data for this motor under any conditions of service, for a maximum velocity of 150. The comparison has been made on the tacit assumption that the test results of curve-sheet 13 represent average losses during running time; if, as is usual, the test values represent average losses during total elapsed time, they must be increased in the ratio of total elapsed time to running time and this increased value used for the cross-section of curve-sheet 12.

This is all for a rise of temperature of seventy-five degrees centigrade; if the permissible rise be sixty degrees, then the permissible loss will be only

$60/75 \times 1.8$ per cent $= 1.44$ per cent

and 12 must be cross-sectioned at

$1.44/1.23 = 1.17$ per cent

to determine the proper accelerations for the various through accelerations.

Curve-sheet 12 then gives the rise of temperature of any motor for any through acceleration, with any initial acceleration, after its cross-section line has once been fixed; for example—for this motor the seventy-five degrees rise is given by the accelerations having for ordinates 1.46 per cent; suppose that for the through acceleration $A = 0.2$, an initial acceleration of 1 be used; then the average loss will be 1.93 per cent, and since temperatures are proportional to losses, the temperature of the hottest part will be $1.93/1.46 \times 75° = 99°$ centigrade. If an initial acceleration of 1.75 per cent be used, the rise of temperature will be $1.00/1.46 \times 75° = 51°$ centigrade.

That is, for any motor and any value of A, the ordinates of curve-sheet 12 will give the rise of temperature for any initial acceleration; each initial acceleration corresponds to a definite rise of temperature for each through acceleration; a vertical cross-section of curve-sheet 12 at any value of A shows the relation of rise of temparture and initial acceleration for that through acceleration. The dotted vertical line on curve-sheet 12 gives the temperature scale for motor No. 13, for $A = 0.25$ and $(a) = 1$, the rise will be 134°; for $A = 0.15$ and $(a) = 2$, the rise will be 40.5 degrees. The temperature scale can thus be drawn in sheet-curve 12 for any motor, knowing its heating constants.

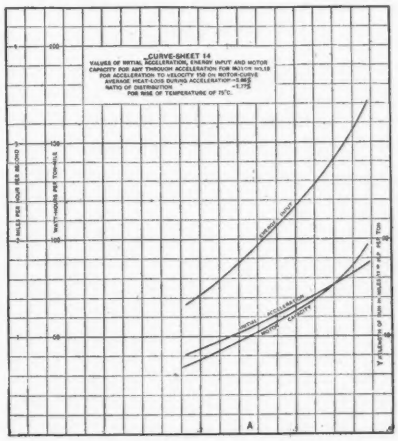
In order to avoid confusion, it is essential to recall that each change of initial acceleration means a proportional change in motor capacity, the motor capacity being directly proportional to the product of initial acceleration and the maximum velocity. It is thus tacitly assumed that the engineer has a complete range of motors of all capacities, all with the same heating constants; but the results are given in horse-power per ton and hence they give merely a determination of the load that any given motor will carry, under the various conditions.

Returning to the example given on page 6, where the initial acceleration was assumed to be 1.25 mph/sec.; if the heating constants of the motor to be used are known, the initial acceleration will be fixed; assume the motor for this run to have these constants:

I^2R loss = 3.6 per cent
Core loss = 2.75 per cent

Then

Ratio of distribution = 2.8 (curve-sheet 11)
Average loss during acceleration = 4.06 per cent (curve-sheet 10)



CURVE-SHEET 14.

Assume,

Radiation at ratio of 2.8 = 1.6 per cent.
Then a horizontal section of curve-sheet 12 having as ordinate $4.12/4.06 \times 1.6$ per cent $= 1.62$ per cent gives, for $A = 0.266$ — the through acceleration under consideration, —
Initial acceleration = 1.5 mph/sec.

and

Energy = 83 wh (curve-sheet 3)

$$\text{Capacity} = 11.6 \left(\frac{7{,}000}{5{,}280}\right)^{\frac{1}{2}} = 13.3 \text{ hp/ton (curve-sheet 4)}$$

This example corresponds to an actual case; the engineers of the project have decided to use an initial acceleration of 1.5 mph/sec., and expect to obtain an energy consumption of eighty-seven wh per ton-mile; these figures agree closely with those above.

Curve-sheet 14 gives what may be called the "characteristic performance" of motor No. 13, used for any schedule. It is obvious that curve-sheets similar to this can readily be plotted for maximum velocities of 125 and 175. A comparison of such curve-sheets for the different maximum velocities will, in general, show slight variations in motor capacity for different initial accelerations for a given schedule. In some cases the minimum motor capacity is attained with an average maximum velocity, say, from 140 to 150; in other cases the motor capacity diminishes as the maximum velocity is increased, up to the limit used in this investigation. No general conclusions can be drawn for the particular relative maximum velocity to be used; this depends principally upon the heating constants of the motor, including the radiation. It is clear, however, that by aid of curves such as curve-sheet 12 for the various maximum velocities, the minimum motor capacity can be found for any particular motor; all that is necessary is to draw the cross-section lines at the proper points, thus fixing the value of the initial acceleration, and then to select the values of energy and horse-power from the different curve-sheets. In the case of motor No. 13, curve-sheet 14 for velocity of 150 gives practically the minimum motor capacity; there is a diminution for greater maximum velocities, but it is comparatively unimportant.

In all cases, the particular initial acceleration leading to the minimum motor capacity should be adopted, even though this initial acceleration does not give minimum energy. The curves give the energy required per ton of total weight; hence the energy required per car is proportional to these figures multiplied by the relative weight of the car. The difference in the energy per ton for any schedule is comparatively slight for the different maximum velocities, and in all cases the energy required per car is a minimum for the minimum motor capacity with which the schedule can be made; the increase in the weight of equipment much more than balancing the diminished energy per ton obtained by using higher initial acceleration and higher motor capacity. Curve-sheet 15 gives the ratio of weight of equipment of different capacities; it is substantially the same as curve-sheet 15 of the former paper. The energy per ton multiplied by the ordinates of this curve-sheet gives relative figures showing the energy per car.

By this method, the two quantities that have, up to this point, been matters of arbitrary choice, are determined, *i. e.*, the initial acceleration and the relative maximum velocity on the motor curve. Having then a motor with known heat-

ing constants, all the conditions which should govern its use for any particular schedule are fixed, and consequently the difference in the results attained by the use of motors with different heating constants is also determined.

I have illustrated the application of this method in comparing the availability of motors with different heating constants for a particular service. It is clear that it can also be used to obtain the data for different schedules. As an example of this use, suppose the data for various schedule speeds for a run of 7,000 feet, with twenty-five second stops, are to be determined. Assume the motor represented by curve-sheet 12, a maximum velocity of 150, and that the motor has a radiation coefficient of 1.6 per cent, for a rise of temperature of seventy-five degrees, at the ratio of distribution 2.44, determined by curve-sheet 11. From these data the following table is deduced, showing the performance of this motor for the different schedule speeds.

Column 1 of table III gives the assumed schedule speed; column 2, the calculated average speed; column 3, the calculated through acceleration; column 4, the initial acceleration from curve-sheet 12, the values being the intersection of the horizontal line having an ordinate of 1.6 per cent, with the several values of the through acceleration; column 5 is taken from curve-sheet 3; column 6 is taken from curve-sheet 4; column 7 is the ratio of the numbers of column 6, and gives merely the relative capacity of motor equipments required; column 8 gives the relative weights of motor equipments, from curve-sheet 15; column 9 gives the relative total energy; it is obtained by dividing the product of the figures of columns 5 and 8 for any schedule speed, by the corresponding product for a schedule speed of twenty-five mph. Since the weights are all given for a motor car of a definite seating capacity, these figures give the relative energy requirement per car seat, or per passenger, for the various schedule speeds.

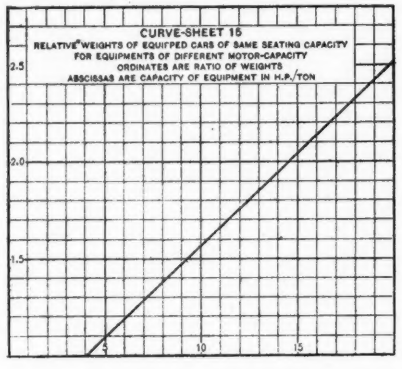
The curve-sheets show initial accelerations as high as three mph/sec., and through accelerations up to A = 0.4; these values are beyond the range of practice, both on account of the excessive motor capacity demanded and the close approach to the slipping point of the wheels, with the usual percentage of total weight on drivers. The boundary lines of the curve-sheets can fairly be taken as

$$A = 0.1 \text{ to } A = 0.3$$

and

$$(a) = 0.8 \text{ to } (a) = 2$$

This indicates the comparatively narrow limits within which all schedules are brought by the use of the quantity A.



CURVE-SHEET 15.

It is obvious that the methods outlined here can be applied to alternating current motors by the use of appropriate speed-torque curves in place of those of curve-sheet 2.

The method which has been developed takes account of all the factors governing the rise of temperature of motors under conditions of service. While certain assumptions have of necessity been made—as, for instance, a constant value for train friction—it is perfectly feasible to recalculate the curve-sheets with other values of train friction; a set of curve-sheets similar to curve-sheet 12, including as many maximum velocities as may seem desirable, can be prepared and used as standard curves from which the rise of temperature of any motor can be determined very simply, for any conditions of service.

While the results obtained by this method are of necessity an approximation because of the number of assumptions that it is necessary to make in developing the method, yet numerous applications of the curve-sheets to practical examples have shown that the approximation is close, and that the curves furnish a useful means for determining the performance of any motor in service.

TABLE III.

Schedule Speed.	Average Speed.	Through Acceleration.	Initial Acceleration.	Wh/Ton.	Hp/Ton.	Relative Motor Capacity.	Relative Weights of Equipment.	Relative Total Energy.
1	2	3	4	5	6	7	8	9
25	28.8	.174	1.04	58	9.2	100	1.49	100
27.5	32.1	.216	1.25	69	10.9	119	1.65	132
30	35.6	.266	1.52	83	13.4	146	1.89	181
32.5	39.1	.320	1.87	102	18.5	201	2.37	280
35	42.9	.386	2.34	134	26.5	288	—	—

A New Interest in Platinum.

Ever since the discovery, in December, 1901, of the platinum group of metals in the copper ores of the Rambler mine, Wyoming, interest in that scarce and valuable metal seems to have been greatly stimulated. One indication of it has been the increased demand for bulletin No. 193 of the United States Geological Survey, which is a report by Professor James A. Kemp on the "Geological Relations and Distribution of Platinum and Associated Metals." The original issue having been exhausted, the Survey has ordered a reprint of the bulletin.

It is unfortunate that the world's known supply of platinum is so limited. The uses of the metal would be greatly increased if it could be obtained in sufficiently large quantities to lower the price. There is, unhappily, for many purposes, no metal to take its place, and the limited supply maintains its price almost equal to that of gold. The demand for it has been somewhat increased in the last few years by the discovery of a use for osmium, which occurs to a considerable extent in American platinum as the mineral osmiridium. Its presence formerly interfered very seriously with the sale of the crude platinum product, as it is a heavy, hard, refractory mineral that made the treatment of the platinum very difficult. Osmium is now required for the manufacture of the filaments of the new Auer incandescent electric lights, so that platinum, both on its own account and on that of its heretofore despised attendant, osmiridium, has become wholly desirable.

According to Professor Kemp platinum deposits occur in three forms or ways: (1) In placers, as exemplified by those in the Urals, Colombia, Brazil and British Columbia. (2) In veins, as at Tilkerode in the Hartz; Minas Geraes, Brazil; Santa Rosa, California; Beresovsk, Russia; Gualdalcanal, Spain; and the Rambler mine, Wyoming. (3) Disseminated in eruptive rocks, in two ways; (*a*) in sperrylite, with the copper-nickel ores in uralitized norite, Sudbury, Canada, and (*b*) as a native metal in basic eruptive rocks, especially peridotites, frequently intimately associated with chromite.

The conclusions of practical value arrived at by Professor Kemp are: 1. That platinum is very sparsely distributed in the mother rock, so that the chances of finding it in quantity sufficient to mine are small; also, if found, the problem of recovering the platinum other than by stamping and washing is yet to be solved; furthermore, the metal may be in a very finely disseminated state, and its extrac-

tion will necessarily be difficult. 2. Large and permanent placers should be sought only on very old land areas, which have been subjected to protracted degradation and concentration. 3. In the assay of antimonial, arsenical, and other copper ores (especially tetrahedrite) it is advisable to search for small percentages of platinum. 4. Deposits of chromite should be tested for the presence of the metal.

A New Auto Record.

Charles L. Edgar's electric automobile, equipped with the new Edison storage battery, which made the run described in the ELECTRICAL REVIEW for October 31, from Boston to New York in remarkably good time, made the return trip from New York in the time of forty-eight hours and thirty minutes. The carriage has double-motor equipment, sixty-eight cells of Edison battery and solid tires. The total weight of the carriage, without driver, is 3,150 pounds.

H. M. Wilson, who ran the carriage through to New York on the previous trip, started on the return trip to Boston on Friday evening, October 30, at 5.35 o'clock, the start being made from 1684 Broadway, the central auto station. Stamford was reached at 9.10 A. M., stopping fifteen minutes on the way. The battery was put on charge at Stamford at 9.16 A. M., at a high rate, for three hours. Leaving Stamford at 12.36 P. M., the railroad bridge at Bridgeport was passed at 2.30 P. M., and New Haven was reached at 4.18 P. M. The cyclometer reading was seventy-nine miles from New York. The battery was then given a little less than three hours charge and the auto left New Haven at 7.30 P. M. being driven by F. H. Sadler, of the Edison Storage Battery Company.

As Mr. Sadler had never been over the road, and as the run was to be made at night, a man was hired to accompany him to Springfield. A quick run was made to Hartford, arriving there at 11.05 P. M. The battery was put on charge at 11.10 P. M., for two hours and fifty minutes, at 100 amperes; after the first half hour, however, owing to the wiring of the carriage getting hot, this rate was reduced. Mr. Sadler then headed for Springfield at 3 A. M., Saturday.

At 4.30 A. M., in pitch darkness, the headlight revealed a sharp turn in the road. The auto was going at full speed, and before Mr. Sadler could change his course he found himself plowing through red mud and broken sods. In a few seconds the rear wheels settled down to their hubs in it and the motors were quite out of sight. After vain attempts to get it back into the road, a native near by was persuaded to leave his warm bed and hitch up his team of horses. With their assistance the auto was soon on the beaten road again and none the worse, except for the extra load of real estate which it brought with it into Springfield. Springfield, owing to this delay of one hour and forty-five minutes, was not reached until 7.21 A. M. The battery was then put on charge for four hours and twenty-five minutes at as high a rate as possible.

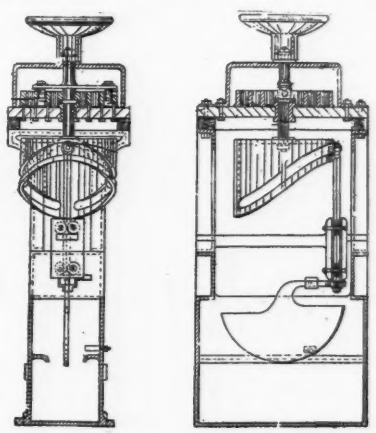
The start was made from Springfield at 1.07 P. M., Mr. Wilson being accompanied by W. G. Bee, of the Edison Storage Battery Company. Between Springfield and Worcester some very bad stretches of sandy road were encountered, and for much of the way the motors required double the normal amount of current, even on level portions of the road. After climbing the long steep grade at Spencer, the speed had greatly diminished; and it was deemed expedient to stop at the electric light station and obtain a short charge if possible. Upon arriving there, there was a delay of one hour waiting for the engineer to come, and when he finally did arrive it was found that there were no facilities for charging.

The only thing to do was to keep on and be as economical of current as possible, and in a few minutes the long down grade into Worcester carried them well into the city. After two miles or more at a snail's pace, the charging station was reached, and none too soon, the battery being so low that it was necessary to push it up the incline to the garage. The charge of three hours and forty-five minutes at a high rate was then given the battery, and Messrs. Bee, Sadler and Wilson started off at 1.50 A. M. Sunday for Boston, passing through Marlboro, Framingham Centre, and following the line of the Boston & Worcester cars to Wellesley Hills, and then through the Newtons and into Boston, arriving at the Electric Vehicle Company's station on Stanhope street, at exactly 6.05 A. M.

The total elapsed time from New York to Boston was forty-eight hours and thirty minutes, and the actual running time was twenty-two hours and fifty-two minutes, the average speed being 10.8 miles per hour. Had the motors been geared for a higher rate of speed the actual running time could have been materially decreased, the battery being capable of a much higher rate of discharge. The total cyclometer readings going to New York and returning were remarkably close. From Boston to New York the cyclometer read 249⅛. On the return trip, although some changes were made in the route, the cyclometer read 249½.

A Liquid Rheostat.

A convenient form of liquid rheostat has been developed by Messrs. Steel, Peach & Tozer, of Sheffield, England. The liquid is contained in a rectangular box of iron, which forms one electrode. Into this a semi-circular plate of iron dips, the motion being imparted to it by means of a roller connected to a stem extending from the plate, and a cam which is turned by means of a hand wheel placed on the top of the rheostat. Connection is made with the plate through brass rings and sliding blocks. The rheostat is connected in such a manner that turning the hand wheel to the right starts the motor in one direction, and turning it to the left starts it in the other. When the dipping plate has reached the limit of its motion, a contact block short-circuits the rheostat. This type of starting box is now being used by



NEW TYPE OF LIQUID RHEOSTAT.

the makers for controlling the motors used in their mills. It is said to be suitable for voltages up to 900, and for motors of any horse-power.

The Advisory Committee on the Building Fund of the American Institute of Electrical Engineers.

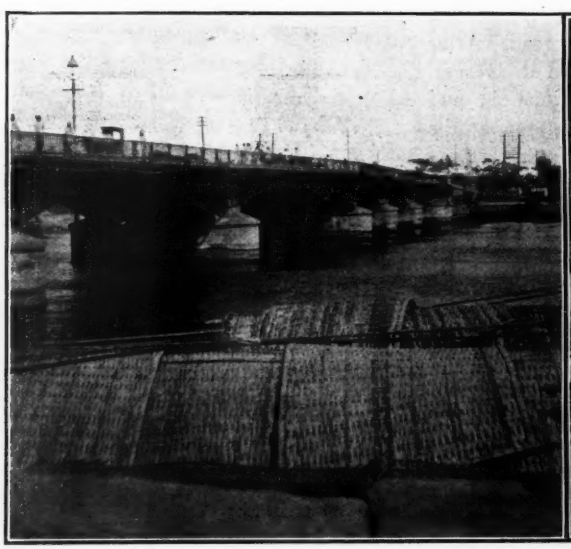
The following gentlemen have been appointed by President Arnold as members of the advisory committee on the building fund of the American Institute of Electrical Engineers, for the year ending September 25, 1904: Mr. Union N. Bethell, 15 Dey street, New York city; Mr. N. F. Brady, 57 Duane street, New York city; General Eugene Griffin, 44 Broad street, New York city; Mr. Charles W. Price, 13 Park Row, New York city; Major Samuel Reber, army headquarters, Washington, D. C.; Mr. J. H. McGraw, 114 Liberty street, New York city; Mr. F. J. Sprague, 20 Broad street, New York city; Professor Elihu Thomson, General Electric Company, Lynn, Mass., and Mr. Samuel Insull, 139 Adams street, Chicago, Ill.

CABLE LAYING IN MANILA AND A TRIP AROUND THE WORLD.

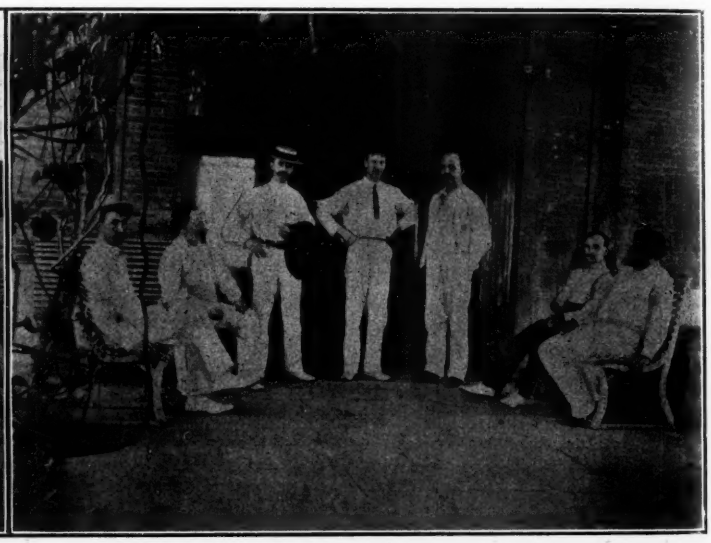
BY LEWIS G. MARTIN.

Around the world in 137 days is not an extraordinary performance, but allowing for a stop-over of three days in San Francisco, sixty-six days in Manila, four days in Hong Kong and twelve days in London, which leaves seventy-two days of actual travel, makes it appear more like a hustle.

In the ELECTRICAL REVIEW of February 14 I gave an account of experiences on my expedition to San Francisco and Honolulu, to lay land cables for the Commercial Pacific Cable Company. My commission this time was to proceed to Manila to do similar work for the same company.



BRIDGE OF SPAIN, PASIG RIVER (MANILA).



OFFICERS OF CABLE COMPANY, MANILA.

Reading from Right—Messrs. Jones, Martin, Grey, Pattison, Grant, Cuttriss and Cameron.

Leaving New York on April 29, I arrived at San Francisco, *via* New Orleans, on May 5, left there on May 8 in the S. S. Doric, and arrived at Manila on June 3. The voyage was a pleasant one, and the following places were called at en route: Honolulu, Yokohama, Kobe and Nagasaki. At Yokohama I made one of the party of five that left the ship and traveled over land to Kobe. This was a very interesting trip from every point of view. After spending a few hours in Yokohama, which is a prosperous and well-kept city of 190,000 inhabitants, we took train for Tokio, the capital of Japan. There we visited the principal temples and tombs of the great Shoguns, and graves of the forty-seven Ronins, famous in Japanese history as powerful and aggressive rulers, drove through the grounds of the Imperial palace and did the city generally. The palace and grounds are protected by a wall and moat and are very well kept up. Tokio has a population of 1,500,000 and is rapidly becoming modernized. An electric traction line is now in course of construction which is to connect up all the principal points of the city.

From Tokio we took train for Kioto, a city of 350,000 inhabitants, famous for its temples. En route we had several views of the celebrated volcano, Fuziyama, from base to summit, a magnificent sight, rising as it does several hundred feet above the surrounding mountain peaks. Kioto, the old seat of government, is a large manufacturing centre noted principally for its silks and embroideries, porcelain, bronzes and metal work of every description.

Our next stopping place was Osaka, where an international exposition was being held. This we visited, and were surprised to find how well every country —particularly the United States of America—was represented. The electrical exhibits, though not very large, were well selected. Other distinguished visitors at the exposition the day we were there were the Crown Prince and Princess of Japan and suite, and we paid double entrance fee for the privilege of being in their company. Osaka is the second largest city in Japan, having a population of 800,000. From this city we proceeded to Kobe, and there rejoined our ship.

Our next port of call was Nagasaki, and after a short stay there the S. S. Doric headed for Manila.

Very interesting from an engineering point of view was the evidence of thoroughness in everything undertaken in Japan. The railroads are well built throughout and well maintained, and, taken as a whole, the telegraph and telephone and electric light lines—all overhead—are models of construction. Hotel accommodation at all the places visited was excellent in every respect, the meals being served in European style, everything well cooked and the variety up to the standard of the average first-class hotel. All the hotel clerks speak English fluently.

The work to be done at Manila was to lay underground in three-inch galvanized iron pipes three four-conductor cables, from the cable houses at Malate to the offices in the town, a distance of, roughly, two and three-quarter miles, two in one pipe and one in another, the single cable being for the Eastern Extension Australasia & China Telegraph Company, Limited, and to be used in connection with its Hong Kong and Ilo Ilo circuits. The cables were similar to those laid in San Francisco and Honolulu, namely, conductor, 170 pounds copper to the mile, insulated with "Okonite," to a diameter of 0.295 inch, each core taped and leaded, the four cores then laid up around a jute centre and covered with lead three-thirty-seconds of an inch thick, each core plainly marked for distinguishing purposes and subjected to breakdown and other tests before being cabled.

After some delay, caused by the late

arrival of the cable and material, work was finally commenced on July 13, and proceeded at the rate of three quarter of a mile lengths per day; and on August 5, the cables being completed, they were handed over to the cable companies. Final tests corrected to seventy-five degrees Fahrenheit gave D.R. 5,063 megohms per mile, and C.R. five ohms per mile for all cores. These are the only properly constructed underground cables in Manila, or, in fact, in the Philippines.

The laying of the cables took twelve days, and the splicing fourteen days, the rest of the time being lost in waiting for pipe and on account of bad weather. For four days the wind, accompanied by terrific rain squalls, blew with hurricane force, which completely flooded our trench and incidentally thoroughly demoralized all telephone and electric light service. The government telegraphs—a pattern of good construction—weathered the storm well.

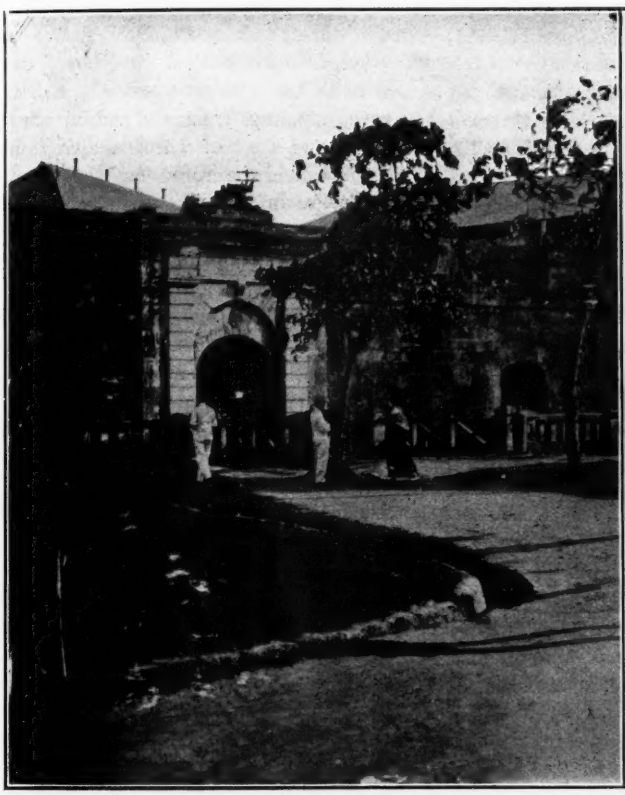
From what had been said of Filipino labor it looked as if there would be much difficulty in securing suitable men for a cable gang, but, thanks to Mr. Moffett, city electrician of Manila, I was able to secure a very good gang of natives and an intelligent native foreman. These men had been trained by Mr. Moffett and had been culled from scores of probationers. Filipino labor is, without doubt, poor, due, of course, to past treatment and neglect, but with intelligent handling and proper instuction can be, as has been proved by Mr. Moffett and others, converted into a useful asset.

Mention was made above of the government telegraphs. These, under the able and efficient management of Major Glassford, of the Signal Corps, are to-day in a high state of efficiency. The telephone and electric light services, however, both run by private corporations, leave much to be desired. All the construction is overhead, and very antiquated at that. The street cars are hauled by native ponies—toy animals out of all proportion to the size of the cars, and when making good time, probably cover nearly three miles an hour. An electric traction company, however, had just completed its preliminary survey when I left Manila, and no doubt has already commenced the construction of lines which are to replace the present ones.

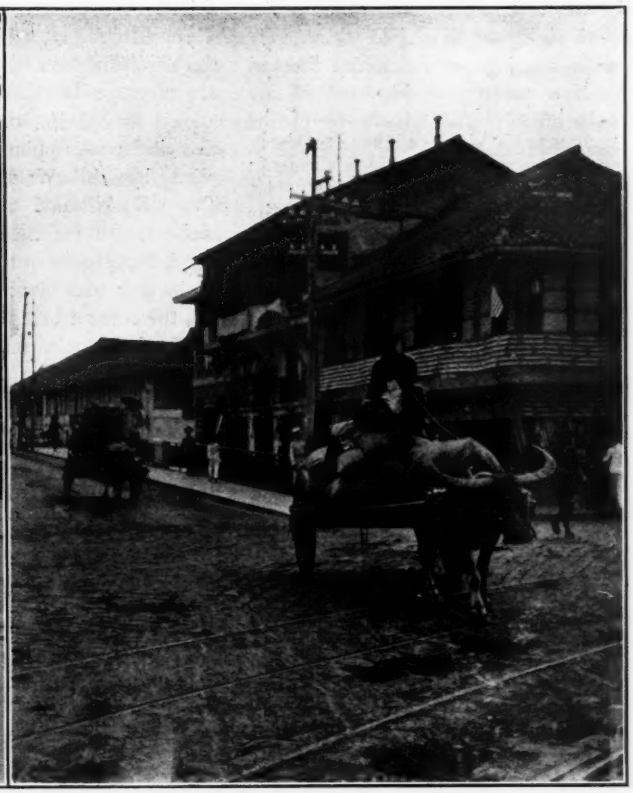
In the Philippines, on account of exceedingly uncertain mail communication, one feels very much out of the world. During my sixty-six days' stay there only three mails came in from the United States, and this, it was said, was about up to the average. One gratifying feature was that each mail brought copies of the ELECTRICAL REVIEW, which is well known and widely read by the electrical and military men in the islands.

My work being completed, I left Manila for Hong Kong on August 8, and after a four days' stay there sailed for London by way of Singapore, Penang, Colombo, Aden, Suez, Port Said, Marseilles, Calais and Dover.

Hong Kong is picturesque and interesting and, of course, very Chinese. Most of the Europeans live on the slopes of the hills, and a prettier sight from the water, when entering the port at night-time, with all the residences lighted up, can not be imagined. An electric car system is in course of construction, which is ultimately to encircle the whole island. At present the only car service on the island is a cable system running from the town to the Peak, which rises very suddenly to a height of 2,000 feet.



ENTRANCE TO OLD CITY (MANILA).



STREET SCENE (MANILA).

Singapore, our first port of call, is a thriving city. The first electric line is now being built, and is to connect up the suburbs and outlying towns. Electric lighting is in a backward state and is almost exclusively furnished by isolated plants. The telephone service here, as in almost all of the eastern cities visited, is of the most primitive character and, according to general opinion, not at all satisfactory. Penang was seen in a hurry on account of our short stay there, and the only things of interest seen were a funeral and a wedding procession, and I had to be told which was which, because

the former looked like a funeral and the latter like a jollification.

Colombo, of tea, spices and jewel fame, our next port of call, was also seen in a short space of time, but there was time enough to note the good condition of the roads, magnificent tropical scenery and an artificial harbor formed by a breakwater which probably is the finest in the world. The officers of the ship said that the breakwater, formed of huge blocks of a special form of concrete, is actually improving with age.

At Aden, Suez and Port Said there was scarcely time to go ashore, so that these must be passed over as simply interesting places as they appeared from the ship.

The trip through the Suez canal, a distance of eighty-seven miles, which took sixteen hours, kept every one on the qui vive. Now passing a ship tied to the banks to let ours pass; then one of the canal company's stations and everybody anxious to know what the signals meant; once being tied up ourselves to let H. M. S. Vindictive, convoying the Terra Nova, sent out by the British Government for the relief of the Discovery, lost in the Antartic, to pass; these and ever-changing scenes on the banks made this part of the voyage as fascinating as it was interesting.

In the Mediterranean, passing through the Straits of Messina, with Italy on the one side and Sicily on the other; and through the Straits of Bonifacio, with Corsica on the one side and Sardinia on the other, was a very pleasant relief from the monotony of a long voyage, and the sight of Stromboli in eruption made everybody feel that they were amply repaid for all the discomforts which must necessarily accompany being cooped up in a ship for five or six weeks.

Marseilles, Calais, Dover and London are too near home to make more than a passing reference to. All are forging ahead electrically. Marseilles has a well-managed electric car service with plenty of cars and good accommodations. There are some well-equipped trolley lines in and about London. At Ilford there are in service double-deck cars with the upper as well as the lower part enclosed—odd looking affairs, but much more sensible than the prevailing all-the-year-round open-top cars.

On September 26 I left London for New York by way of Southampton and Cherbourg, joining the S. S. New York at Southampton. The New York, like most Atlantic liners, is equipped with wireless telegraph, which, from all accounts, though working well is not very extensively patronized by the traveling public.

Since my arrival home on October 3 I have been asked by many which part of the trip was the most interesting to me, and I feel that I can not do better than close this narrative with my reply—"coming up the bay into New York."

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

At the autumn meeting of the institution of Mining Engineers, which was recently held at Nottingham, electricity was almost as much in evidence as at the meeting in London. The autumn meeting has only one day for the reading and discussion of papers, the two following days being devoted to excursions to colleries, and places of interest in the neighborhood. Of ten papers down for reading, three were on purely electrical subjects, and three others contained descriptions of electrical plant or apparatus. There were two descriptions of collieries in the neighborhood, Sherwood colliery and Glapwell colliery, which were visited on the excursion days. Both collieries, which are more or less in the stage which is known as opening out, have three-phase electrical power plant, and both well supplied by the Westinghouse Company. Two fifty-kilowatt machines, with their exciters, are installed at Sherwood colliery, though the pit has only just been sunk, and coal is not even being found yet, the current being used for driving the fitting-shop tools, mortar mills, a stone breaker, and the fan that was used during the sinking operations, by means of induction motors.

The whole of the shot firing required during the sinking operations at this colliery was done by electricity. A shaft-sinking frame was employed, suspended from the surface, on which the men worked, and on which the compressed air rock drills that were employed were carried. Twenty-two holes were drilled at the same time in the bottom of the shaft, vertically downward, six in a circle of four feet radius, and sixteen outside of these, in a circle of nine feet radius, all the holes being six feet deep and two inches in diameter. All the twenty-two shots were fired together, and twenty-four horizontal holes in the side of the shaft were then drilled, in a circle of eleven feet radius. These were all fired together, and it is stated that the blasting left the shaft quite clean, no dressing having to be done afterwards by the pick. The total sinking to 1,400 yards only occupied fifty-four weeks, a very creditable performance indeed, and a great advance upon the previous records due evidently to the intelligent use of the electric shot firing. The shaft bottom was lighted, during the sinking, by six incandescent lamps of thirty-two candle-power each, held in a special fitting, and suspended in the shaft by an armored cable.

At Glapwell colliery there is a 225-kilowatt Westinghouse, three-phase generator, supplying power for three motors of fifty horse-power, one of thirty horse-power, and five of seven and one-half horse-power, at various parts of the colliery. Fifty horse-power motors drive endless rope haulage—secondary haulage, as it is called—drawing the coal trams from distant parts of the colliery to points where it can be attached to the main haulage system, consisting of endless ropes, driven by engines on the surface, the ropes going down the shaft to the main roads, and coming up again, the rate of travel being from one and one-half to three miles an hour. This is one of the favorite methods of working the main haulage systems in Yorkshire and north Derbyshire. Another favorite method in other districts is to have a band rope, virtually a driving rope, running from the engine on the surface to a set of wheels under ground, from which the ropes for the different roads are driven. In some parts of the country, notably at one large colliery in Scotland, the band driving rope is giving place to an electric motor fixed near the pit bottom, fed from a supply service on the bank in the usual way. The other motors at Glapwell are used for driving pumps principally, or for small pieces of secondary haulage. The method of fixing the cables at Glapwell is worth noticing, as part of it is novel. The cables are the usual triple cables employed with three-phase currents each cable consisting of thirty-seven No. 11 copper wires, fully insulated with paper, lead, jute outside, the three cables laid up spirally together in one, and armored outside of all. The cables in the shaft are enclosed in pitch-pine casing, supported to steel channel buntons placed at intervals in the shaft for the purpose. It is stated that the joints in the casing are made so that it is impossible for water to get in. On the roads underground, the cables are laid in puddled clay trenches, slightly wedged shaped in section, and fixed between the two haulage roads.

One of the points to be noticed at Sherwood and at Glapwell, which marks very distinctly the great advance which electricity is making in collieries in this country, is the elaborate nature of the switchboards provided. At both the collieries named, the switchboards have marble panels, with the usual quota of switches and measuring instruments, and the whole arrangement would discredit many of the smaller electricity supply stations of our towns. The switchboards are protected by a handsome wooden rail

in front, and the bulk of the working parts are behind, and can only be got at by going into a small room behind the board, the key of which is kept by the responsible electrician at the colliery. Substantial india-rubber mats are also provided all around the generators, and in front and behind the switchboard.

Glapwell colliery has also been the seat of an unfortunate but interesting accident in connection with the three-phase installation. In the neighborhood of one of the haulage motors there are two switches of the triple form used with three-phase working, and of the type used by the Westinghouse Company, for starting its induction motors. The switch is off when the handle is vertical, throwing it to one side, and then throwing it over to the opposite side is necessary for starting. Fuses connected these two switches, and the fuses were naked copper, and came through a hole in a board from one switch to another. At a certain time, when both switches were in the "off" position—this is quite certain—a man who was at work in the neighborhood of the switches accidentally touched one of the fuses and was killed. His Majesty's inspector of mines, who described the case to the present writer had the matter tested. He had an iron stake driven into the ground at the point where the man stood, and had the pressure taken between the fuse and the iron stake. It was found to be 150 volts. The lights at Glapwell and Sherwood collieries are taken from the three-phase service, at 100 volts by means of transformers. While on the subject of electrical plant collieries, it will perhaps be as well to mention a colliery to which members of the British Association were invited during the recent meeting at Southport.

Hulton colliery is situated near Bolton le Moors, one of the large manufacturing towns in Lancashire, and the seat of the works of the Lancashire & Yorkshire Railway. At Hulton they have adopted Parsons three-phase turbo-generators. Two of 300 kilowatts are already fixed, and two more are to be provided. The turbines are supplied with steam at 150 pounds pressure, and exhaust into a condenser, the steam consumption being twenty-two pounds per kilowatt-hour, with 26.7 inches of vacuum. These figures are given by the colliery as the result of a test made by their own officials last May. The generator is bipolar, the armature rotating at 3,000 revolutions per minute. The current is to be employed for lighting, for haulage, pumping, and for driving forced draft fans, workshops, and in fact everything about the colliery except the winding engines. The feature that is worth noticing, as at Sherwood and Glapwell, is the switchboard. It has seventeen panels, two for the generators, two for the exciters, one for the voltmeter, one for the wattmeter, and eleven for distribution. The two alternators are to be run in parallel, voltmeters and lamps being provided to enable this arrangement to be carried out. The usual arrangement of triple switches for the generators and for the distributing panels is provided, and there are two recording wattmeters. The elaboration of the whole shows more than anything else the enormous strides that electricity is making in connection with mining in this country. In the early pioneer days, and for long after, almost up to recently, it was very difficult indeed to persuade colliery managers to go to the expense of any measuring instruments. If you included them in your tender for a contract, you usually lost the contract, and if you tried to get them in afterwards, you were looked at with considerable suspicion. Coal-cutting by electricity is to be done at Hulton as well as other things.

(To be continued.)

Contact Voltages.

A recent issue of *L'Eclairage Electrique* contains an article giving the results of an investigation upon the influence which the degrees of polish and the superficial densities of bodies have on the difference of electrical potential produced by their contact. The following conclusions are given: Of two surfaces of a particular metal, that which is most polished always becomes positive. When two different dielectrics are brought into contact, the hardest one ordinarily becomes positive. The contrary takes place with metals. When a hard material presents, on account of its structure, few points where contact is possible, it behaves like a soft substance. Glass wool becomes negative in contact with cloth, porcelain and glass. Hygroscopic surfaces, when poorly dried, behave like water. A body which easily crumbles into dust, or a glue-like body which leaves traces on the surface with which it is in contact, becomes negative. Thus, ebonite becomes negative when in contact with emery paper, but it is positive when it is rubbed with a paper in order to polish it. Two pieces of quartz, sugar or pyrite, which give a phosphorescent light when knocked together, are both positively electrified. The particles produced by knocking are, on the contrary, negatively charged.

Electrical Patents.

In the increasing use of electricity for the purposes of advertising, ornamentation, illumination, etc., the compactness, simplicity and effectiveness of the apparatus employed and its constitutive elements are becoming more and more important. Where the current leaves or passes out of the element or member at the same end at which it enters, as in the ordinary incandescent bulb, it is difficult to vary the form so as to give the best results or produce the most

PLAIN VIEW OF ELEMENTS.

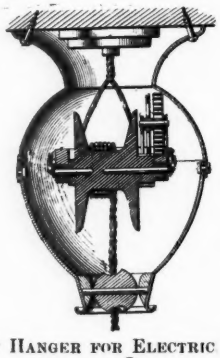
pleasing effect, and in a group of bulbs the several elements have no distinguishing trait or consequential individuality other than what is imparted to the mass. When other forms made on the same principle are resorted to, the cost of construction and application and the inherent defects of the separate members detract from their utility. Mr. Dennis J. O'Brien, of San Francisco, Cal., has assigned to the O'Brien Electric Light Letter Company, of the same place, a patent on a system of electrical characters and means for forming them. The invention is designed to provide a system of this character, embodying a principle which will combine the greatest strength and simplicity of construction with the most effective results, whether the elements are used singly or in groups and also irrespective of their

SECTIONAL VIEW OF ELEMENTS.

size, shape or proportions. Where the invention is to be utilized for advertising purposes, which is the primary object, its elements are made into such shape that the very least possible number of them may be arranged or grouped together to form the different letters of the alphabet. These elements are so constructed that they may also be arranged as symbols, designs, etc., or simply disposed in plain lines for ornamentation or even illumination. The elements may be of any suitable size or dimensions in length or cross-section and are made tubular, with all or a portion of the length of each provided with a transparent light passage or adapted for the passage or emission of light rays from the interior. Each of them is formed from an exhausted glass tube of substan-

tially the same area in cross-section throughout its length. In this manner the different tubes or receptacles with their accompanying parts can be quickly and cheaply formed and arranged into the desired characters with a uniform and well defined outline. Mounted within each tube or receptacle aforesaid is an illuminator, as an incandescent filament, which extends from one end thereof to the other and is placed at each end in electrical connection with an electrical contact, such as a metallic cap or band, which preferably encircles the tube and is secured thereon by means of cement or plaster. As the filament expands and contracts from the effects of the electrical current, it is necessary to provide a means for counteracting such expansion and contraction, which can be done very effectively by an automatic take-up or elastic device for instance, a spring formed or interposed in the length of the filament or its support. In forming the elements as above described, the glass tube is cut off to the desired length and the filament with the platinum strips secured thereon is inserted. One of the strips, preferably the one having the spring, is then sealed in the end of the tube. This will cause the other strip to extend to the other end of the tube, where it is also sealed in after placing the filament under sufficient tension to stretch the spring to such an extent that the expansion of the filament from the action of the current will all be taken up by the retraction of the spring. By sealing in the platinum, having the spring before sealing in the other end, the proper tension can be given to the spring, as the other piece of platinum being straight or plain can be drawn out and fastened at any point, whereas if it were fastened first the spring might extend out too far, and thereby prevent its being sealed in properly to give the requisite tension to the filament. It will be seen that as applied the filament and the platinum pieces form a direct path for the current through the tube from one end to the other, and all danger of damage from the action of the current is avoided.

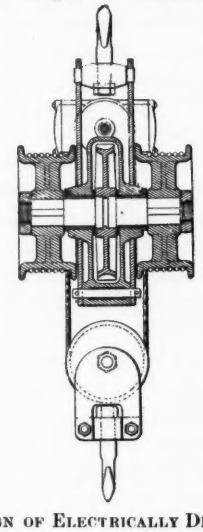
A novel hanger for electrical lamps and the like has been patented by Mr. Michael C. Donahue, of Colorado Springs, Colo., who has assigned a three-fourths interest to John Skinner, F. G. Armbruster, and F. A. Neff, of the same place. The aim of the inventor is to provide a comparatively inexpensive structure, which will support a lamp at any height desired and which will permit the raising and lowering of such lamp without sparking. An open-ended tubular casing is employed, comprising detachably associated sections. The upper section is adapted to be secured to a ceiling and enclose the usual rosette, from which the lead wires extend. This upper section carries at its lower end a horizontally disposed frame, in which is journaled a drum. Spring mechanism geared to the drum serves to rotate the same in one direction. The journals of the frame project through the drum and contain suitable conducting rods, the outer ends of which contact with springs secured to the frame. The leads are connected to the spring by means of fuses. Wound upon the drum and electrically connected to the conducting rods is the lamp wire that extends downwardly through the lower section of the casing and from its lower end. This wire or cord supports the lamp. The lower end of the casing is provided with a horizontally disposed ring, within which is journaled a clutch ball, the cord passing between the ball and the ring. An annular groove is formed in the ball and is provided with



A New Hanger for Electric Lamps and the Like.

oppositely extending lateral grooves that terminate on opposite sides of the annular groove. As long as the cord is in the annular groove it may be drawn downwardly or passed upwardly through the casing, the spring drum taking up the slack and also permitting the cord to unwind. When the desired adjustment has been obtained, it is only necessary to swing the lamp slightly to one side, so that the cord will travel into one of the lateral grooves, and thereupon will be pinched between the ball and ring, consequently securing the lamp at any desired height.

Mr. Frederick A. Waldron, of Stamford, Ct., has devised a new electrically driven suspension hoist and has assigned the patent obtained thereon to the Yale and Towne Manufacturing Company, of the same place. The invention consists in a hoist with a single point of suspension and comprising a motor, a worm-wheel, a drum, a worm-shaft, the worm-shaft being located at an angle to the armature-shaft on the motor and on the side of the suspension point opposite the motor. Suitable suspensible plates are mounted at their ends on the crosshead to a crosshead which covers the suspension hook. This hook is swiveled in the crosshead so as to permit the hoisting mechanism suspended therefrom to turn freely thereon, and is located in line with the lower hook, which receives the load, which line is of necessity the centre line of the tackle as a whole. The side plates are curved laterally at their upper ends, the crosshead carrying the suspension plates being mounted in these curved ends near the free ends of the latter, and they are secured together in parallel relation by a crosshead by spacing bolts and by the casing. This casing is made in two sections bolted together and is of general cylindrical shape to comfortably cover

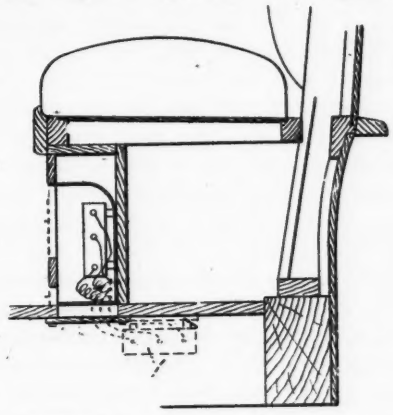


New Design of Electrically Driven Hoist.

and enclose the worm-wheel. This casing is provided near its centre with enlarged hubs, which latter are mounted in openings formed in the suspension plates. The lower end of the casing is enlarged to span the space between the two plates and is locked to the latter by a bolt or pin. Mounted in the hub of the casing is the shaft, and secured to the shaft within the sectional casing is the worm-wheel, and to the ends of the shaft outside the plates are the winding-drums. The hoist cable or chain is secured at its ends to the drums. Hence when the latter are rotated by the rotation of the worm-wheel, the cable or chain will be wound upon or unwound from the drums, as the case may be. This cable or chain carries the hoist-pulley. Secured to the casing is the electric motor. The motor is located at one side of the suspension point and receives its current through wires in the well-known manner and is provided with the

ordinary switch and rheostat by which the movement of the motor is controlled and, if desired, may be provided with a brake for holding the load suspended and for regulating the descent of the load. With a screw in which the pitch or angle of the threads renders it self-holding a brake would not be necessary, but with a screw that is not self-holding a brake would be desirable. The armature shaft of the motor passes between the suspension plates and a point beyond the centre line of the tackle and is mounted near its free end in a bearing, secured to or integral with the casing. Secured to the free end of this shaft is the bevel-pinion which meshes with another bevel-pinion secured to the worm-shaft. The rim of this piston rests below and inclines downwardly from an armature shaft at an angle of the latter and the body or spokes of the pinion project downwardly in the form of a cone, so as to bring the hub of the pinion close up to the side of the casing on the side or edge farthest removed from the motor. The pinion and its hub are enclosed by the conical casing secured to the other casing. The casing is provided on its side or edge opposite the motor with a housing in which the worm-shaft is mounted. This shaft normally rests in an inclined position wholly to one side of the centre line of tackle and at an angle to armature-shaft, and rests at its lower end in the step held in place by a lower removable cap. The interior of this housing is somewhat greater in area than the diameter of the worm-shaft, thus forming an oil-chamber in which the thrust-bearing may be submerged.

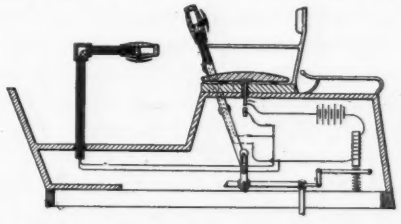
The Westinghouse Air Brake Company, of Pittsburg, Pa., has purchased a patent from Mr. Edwin M. Herr, the entire interest in a patent granted to him on an electric heater for cars. The invention relates especially to that class of heaters which also serves as resistance devices or rheostats for the controller of electric cars to regulate the current supplied to the motors or to regulate the current generated in a local brake circuit; and it has for its object to provide means whereby the heater may be located in a position to warm the interior of the car during cold weather, as in winter, and may be moved to another position where its heat does not affect the interior of the car during warm weather, as in summer. Heretofore two resistance devices have been employed for this purpose—a rheostat located outside of the car and an electric heater located within the car—with a switch for connecting either the outside rheostat or the inside heater into the circuit for controlling the starting and stopping of the car. This necessitates a double equipment and connections, which is very expensive, while by the use of the present invention the electric heater may be used as the controller resistance device at all times and the outside rheostat and its connections may be dispensed with altogether.



SHOWING ARRANGEMENT OF ELECTRIC CAR HEATER.

This invention therefore consists in a movable electric heater which may constitute the resistance device or rheostat for the controller of an electric car and is adapted to be moved from one position, where its heating effect is utilized to warm the interior of the car, to another position, where its heat does not affect the temperature of the interior of the car. The electric heaters are normally supported beneath the seats of the car and may be secured by means of screws or in any suitable manner to the usual upright pieces. An air-casing having top and bottom front openings and a deflector for the circulation of air over the heater may be employed, if desired. As the heater also constitutes the resistance device or rheostat for the controller to regulate the current in starting and stopping the car and is subject to the heating effects at all times when the car is operated, means must be provided whereby the heating effects will not render the interior of the car uncomfortable during warm weather. For this purpose there is an opening normally closed by a cover in the floor of the car beneath the heaters, and the heaters are provided with flexible electrical connections, whereby they may be lowered through the openings in the floor and secured outside of the car, where their heat will have no effect upon the temperature of the interior of the car.

Mr. John D. Ihlder, of Yonkers, N. Y., has assigned to the Otis Elevator Company, of East Orange, N. J., a patent obtained by him on a novel motor control. The object of the invention covered by this patent is to enable a motor to start with any load and practically unlimited current, without the aid of a mechanical dash-pot controlling the starting resistance. In place of this usual dash-pot, the inventor provides an electrical equivalent of the same so arranged that the starting resistance is not short-circuited too rapidly. The motor may be of any suitable type, but preferably shunt-wound adapted to be connected in circuit with the supply mains and provided with a series field winding and a shunt field, the shunt field being also connected to the mains. A suitable switch is arranged to control the admission of current to the motor armature, and the throwing of the switch lever into engagement with the contacts will first complete the circuit of an electromagnet, connected across the mains and controlling contacts in the main armature circuit. The energizing of this magnet closes these contacts and completes the circuit to the motor through the resistance and the series field winding. Instead of a mechanical dash-pot or other equivalent mechanical means for regulating the operation of short-circuiting the starting resistance, a series of magnets is provided of which there may



SHOWING ARRANGEMENT OF CONTROLLING DEVICE FOR MOTOR VEHICLES.

be any desired number, connected across the line and receiving the line potential. These magnets are arranged for a high time constant, taking three or four seconds, for instance, to come to a full magnetization. Large magnets are therefore required or additional means are needed for accomplishing this end, as for instance, an additional coil having a high time constant connected in series with the magnets, which may be termed the "accelerating magnets." The magnets are wound to different strengths, so that the first operates to attract its armature with less current strength than the second, and the second has a like relation to the third. The inventor states that any other equivalent construction and arrangement of magnets may be provided so that the resistance and series field will be gradually short-circuited as the motor starts. The time constant of the accelerating magnets may be made adjustable by providing an adjustable winding as a shunt in a magnet, or by varying the position of the iron core in the coil thereof.

Notes from Great Britain.

By Our Special Correspondent.

THE Board of Trade recently issued a return of the capital, traffic, receipts and working expenses of the railway companies of the United Kingdom for the year ended December 31, 1902. Naturally this has largely to do with steam railways, but the figures relating to the few electric lines of this character which we have are not without interest. The report mentions nineteen authorized electric railway companies, the total authorized share and stock capital of which was some $120,000,000, the loan and debenture stock amounting to $41,250,000. Of these companies, however, six had raised no capital whatever on December 31, 1902, and, leaving these concerns out, the total capital paid up on the date in question, including loans and debenture stock, was $57,000,000. There are actually eight undertakings under the heading of railways (as distinct from tramways) in operation, having a total length of track (equivalent of single) of eighty-eight miles. The total gross receipts on all these, from every source, amounted to $3,750,000. On six of the lines in operation the percentage of expenditure to receipts is as follows—72, 56, 52, 44, 80 and 47. By the date of the next report the Mersey Railway will be included, when an interesting comparison can be made as to the difference between steam and electric traction. The lines dealt with in the report above referred to include three tube railways, one overhead railway, three that are a combination of tramway and railway, as they run on both public and private roads, and one exceptional line which runs on the seashore with a gauge of eighteen feet. But the figures of the latter are not very large, being included in the report for the sake of completeness. There does not at present seem any prospect of further electric railways being opened this year, although the Metropolitan and Metropolitan District conversion is well on the way, as well as several of the Yerkes tubes. The Lancashire & Yorkshire Railway is also in process of reconstruction for electric traction, while preliminary trials have been made with cars on the North Eastern Railway, which scheme has often been mentioned in these notes.

Two instances of municipal trading, which have been spoken of previously but which seem always to provide something new to report, have done much to reduce the dignity of town councils, albeit there are not many of this description about. First, with regard to the purchase by the Marylebone Borough Council of that portion of the Metropolitan Electric Supply Company's business which lies within its area. I have before recounted the circumstances of this, how the council had to buy at a high figure under special circumstances, and that as soon as the purchase price was made known a large section of the ratepayers were immediately up in arms against it. But the council was obliged to see the thing through, and ever since 1901 has been beset with difficulties at every turn. The council had contemplated securing the company's business on advantageous terms to itself. Since the award, however, great difficulty has been experienced in procuring a loan to complete the purchase, neither the London County Council nor the Local Government Board feeling itself legally able to grant a loan until the transfer has taken place, and evidently the company will not sanction the transfer until the money is forthcoming. That is the present position. But the council will no doubt promote a bill in Parliament next year.

The municipal telephone exchange, which has just been erected by the Brighton corporation under a license from the Postmaster-General, has just been opened for public service. The system adopted is the automatic ring-through system, the subscriber only having to lift the receiver from the hook to call the exchange and to replace it in order to ring off. A special feature is that in the event of a called subscriber not responding at once, the caller may himself ring without affecting the exchange. The switchboard is at present fitted for 1,000 subscribers, but will ultimately have a capacity of 5,000. Twenty-five miles of conduit have been laid, this portion of the work only having been commenced in March of this year. The cable, which has been drawn into the ducts, commences at the exchange with 626 wires and extends to the borough boundary on all sides, gradually diminishing, as connections are made to subscribers' premises, to twelve wires at the extremities. The number of wires at the exchange end is at present 3,000. The number of applications for connection now greatly exceeds 1,000, and extensions are to be immediately put in hand. The annual subscription is $27 for unlimited service.

A small electric lighting and tramways system has just been opened at Bexley, in Kent, in which both single-phase and continuous current supply is given. Generation takes place at 2,100 volts, which is then transmitted to substations situate in kiosks in the streets, which also serve as arc lamp posts. As a matter of fact, a 150-kilowatt single-phase alternator, working at 2,100 volts and fifty periods per second, and a 150-kilowatt shunt-wound continuous-current generator are directly coupled to two engines, the idea being to keep the steam engine load-factor high. Westinghouse transformers reduce the current to 400 volts. Messrs. J. G. White & Company had the contract for the permanent way of the tramways, which is not a very extensive system at present.

Good progress is being made with two power companies which have been authorized but a short time. One, the Yorkshire company, has accepted tenders for 6,000 horse-power of plant together with the necessary equipment for transmission and distribution. The first power station will be built at Thornhill, and the contractors are already in possession of the land. The latest type of Curtis steam turbine, which will be manufactured by the British Thomson-Houston Company, is to be used. It is expected that power will be available in about ten months. The Lancashire Power Company has entered into a contract with a construction company for the erection of works, and the work is being proceeded with.

Some interesting figures are given relative to the all-British Pacific Cable in a newly published return. This shows the sums issued from the consolidated fund authorized by the Pacific Cable Act of 1901. By this act $10,000,000 is authorized. Up to the end of March, 1903, over $9,000,000 had been expended. The full $10,000,000 authorized has been borrowed and the first payment of the annuity which has been created as security is due in December, 1903, the last being payable in December, 1952. The actual traffic receipts during the year were slightly under $10,000. There is a grant in aid in addition and the balance on hand at present is nearly $150,000.

A. W.

London, October 31.

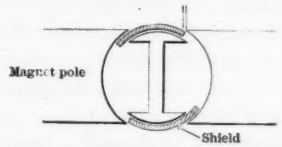
Electrical Notes from Europe.

By Our Special Correspondent.

ONE of the latest improvements in the way of sparking devices for petrol motors is that which is used on the Pengeot automobile, one of the leading Paris makers. The magneto which produces the current for the spark is disposed as shown in the diagram. Between the poles of a permanent magnet is placed a shuttle-wound armature. The latter is also fixed, and the variation of flux is obtained by a revolving shield of soft iron which moves between the field and armature and thus generates a current in the latter. To produce the spark for igniting the explosive mixture of the motor, the following device is adopted. A cam A (see diagram), operated by the motor, works a rod B which can move up and down. The rod is held against the cam by a spring R. It carries at the top of the trip piece C which engages with the lever arm on the right. This lever is mounted on a movable shaft D which passes into the cylinder through a tight joint. The lever carries an arm E on the end inside the cylinder (shown in dotted lines), which serves to make or break contact with an insulated metal piece M which is inserted in the cylinder. A spring on the outside keeps the arm E in contact with M. When the rod B is pushed up by the cam, the trip C pushes up the end of the lever G and causes a break between E and M. The spark passes between these two points and ignites the gas. As the cam continues to revolve the rod falls into a depression in the cam and the spring establishes the contact between E and M. The circuit from the magneto has one wire connected with the insulated piece M and the other with the mass of the motor.

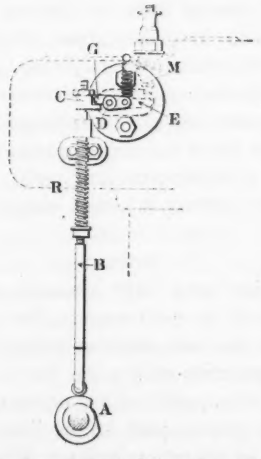
An exposition of considerable interest is to be held at Milan in 1905, in which the mechanical and electrical sections will occupy an important place. The exhibits of the electrical section will include apparatus relating to electric traction, dynamos, motors, etc. A special section will be devoted to telegraphy and telephony. Wireless telegraphy is to be well represented, and especially the latest forms of portable stations for field work.

An electrically operated pumping plant has been recently installed in Greece in connection with the draining of lake Copais, which has been an important enterprise. The streams which fed the lake have been turned out of their course, and the ground forming the bed of the lake is now utilized for agricultural purposes. The lake formerly received a number of streams coming from the slopes of Mt. Parnassus and Mt. Helicon. The Melos



MAGNETO FOR PENGEOT AUTOMOBILE IGNITER.

and Kephisos rivers are the largest of these streams, to which were added a number of mountain torrents whose volume was greatly increased in the winter. To draw off the water of all these streams and divert it into the basin of the neighboring lake Likeri has been an important piece of engineering work. The water comes through an underground tunnel and empties into the lake, and between the tunnel and the surface of the lake there is a difference of level of twenty-five or thirty feet. It was decided to utilize this fall by constructing a hydraulic plant which would generate sufficient current for operating the drainage



PENGEOT AUTOMOBILE METHOD OF IGNITION.

pumps which are needed in the basin of the old lake. It is found necessary to drain out the water which collects at points which are below the level of the drainage canals, especially during the winter season. Steam pumps have been used for this purpose up to the present, but fuel is very expensive in this region and needs to be brought in from long distances. The use of electric motors for driving the pumps will thus give a great economy. The remainder of the current furnished by the plant will be utilized for the local lighting and also for operating electric motors in the neighborhood for agricultural work. The new plant uses two turbines of the Francis type, coupled to three-phase alternators of 150 kilowatts each. These machines work at 280 revolutions per minute and deliver 500 volts. The current is sent direct from the machines to the pumping plant without using transformers. From the switchboard a three-wire line, mounted on wood poles, leads for eight miles to the pumps. The poles also carry a telephone line. The drainage pumps lift the water thirteen feet high at the rate of 250 gallons per second. The electrical outfit for the pumps, as well as the station plant, has been furnished by Ganz & Company, of Budapest. At present two pumps have been installed on the above system. Each is driven direct by a three-phase motor of eighty horse-power, working at 490 revolutions per minute.

The researches of Professor Kohlrausch seem to prove that radium rays have a certain effect in increasing the electrical conductivity of water. The experiments were carried out with rays which were emitted by a bromide of radium and barium which after passing through an aluminum screen of 0.17 millimetre were sent through a layer of water eighteen millimetres thick. The water must be kept under action of the rays for some time in order to observe an appreciable effect, but after a certain time it is found that the electrical conductivity of the water is increased. To account for this phenomenon two different hypotheses have been advanced; first, that of a direct formation of ions in the liquid, and second, the action of the rays upon the glass of the containing-vessel.

The new physical testing laboratory which has been lately fitted up at the Conservatoire des Arts et Metiers at Paris contains some of the most recent improvements in the way of electrical testing apparatus, among which may be mentioned several new forms of electric furnace for laboratory work. They have been installed for making different tests upon metals at high temperatures. Two of them are of the incandescent type, while a third uses the arc for heating. The Heraeus electric furnace uses a porcelain tube which is wound with a thin

platinum strip forming the incandescent conductor. This type of furnace can be constructed more cheaply than one which uses platinum wire for the winding, as the strip winding uses a less quantity of platinum. In the Heraeus furnace the strips are cut out of thin sheet metal which is only 0.007 millimetre gauge. The strip adheres closely to the surface of the porcelain tube and gives a good contact, while at the same time it affords a large heating surface. One of the furnaces which has been installed at the laboratory is of the vertical type, while the second has the tube placed horizontally. In the vertical form the tube is six inches high and the quantity of platinum which is needed for the heating coil is relatively small, being only five grammes in all. A temperature of about 1,400 degrees centigrade can be obtained by the incandescent spiral, using a current of 110 volts and fifty amperes; or 5.5 kilowatts. To regulate the temperature the furnace is provided with a small switchboard which contains a rheostat for changing the voltage at the terminals of the spiral. In this way the temperature of the furnace can be kept within the limits of 1,200 or 1,400 degrees centigrade. The vertical form of furnace is designed to receive a small crucible in the interior and is used mainly in determining the fusing points of metals or alloys. The horizontal furnace is formed of a percelain tube twenty-four inches long and two and one-half inches inside diameter. It uses a somewhat higher weight of platinum than the former, or twenty grammes. It is used for making temperature tests on different metals as well as traction tests upon metals in the form of wire or rods at high temperatures. This furnace is also provided with a rheostat for changing the temperature or keeping it at a constant point. The third electric furnace uses the heat of the arc for melting small quantities of metal in a crucible or for heating small pieces. The crucible is placed between two arcs which are formed on either side of it between pairs of carbons. The arcs are connected in series on 110 volts, with a rheostat in the circuit. The crucible rests upon a base of refractory material which passes through the bottom of the furnace. An ingenious device has been adopted in order to give a movement to the crucible so that the arcs will not always strike it in the same place and so deteriorate or melt it at these points. This device rotates the crucible and at the same time moves it up and down. The refractory base which supports the crucible is fixed on the end of a vertical shaft. A large pulley on the shaft is connected by a belt to a small pulley on the shaft of an electric motor, and the crucible is thus rotated at slow speed. To give the up-and-down movement, the shaft carries a soft iron armature at the lower end which can be attracted down by an electromagnet placed beneath it. On the shaft is a commutator which makes or breaks the current in the electromagnet as the shaft revolves, and causes the electromagnet to draw down the shaft at regular intervals against the action of a spring. This type of furnace has proved very successful and different metals, such as iron or nickel, can be melted in a few minutes. The heaviest current used is about seventy-five amperes, which with 100 volts makes a consumption of 7.5 kilowatts. Starting from a cold furnace it takes only fifteen minutes to melt fifteen grammes of nickel.

According to the annual report of the Electric Lighting Company, of St. Petersburg, for the year 1902, the total length of the cables operated by the company is 326,483 metres for public and private lighting. The total number of transformers is 8,937, and meters 5,191. The public lighting is the equivalent of 6,450 lamps of ten-candle-power. The company has 6,208 subscribers for light and power. Among these the winter palace of the Czar uses the largest number of lamps. The total for public and private lighting is the equivalent of 240,044 ten-candle-power lamps. Incandescent lamps figure in the total consumption of current for 88.8 per cent; arc lamps, for 4.4 per cent; motors, 6.1, and electric fans, etc., 0.7.

A project for a large hydraulic station, which is to be used mainly for traction purposes, has been lately submitted to the Italian government by the North Milan Railway Company. This company controls the greater part of the lines which are now in operation between Milan and the Italian lake region, besides several lines of tramway in the city of Milan. According to the present project the hydraulic power is to be obtained from the river Liro. The company has applied for a concession for an 850-foot fall which is expected to give 5,600 horse-power. Most of the current will be utilized for operating the railroad or tramway lines, and the rest for electric motors in various factories in the region. According to the present project the hydraulic plant will be located on the left bank of the Liro, near Chiavenna. The station will contain five turbines of the horizontal type, each having a capacity of 1,000 horse-power. The alternators, which will be direct-coupled to the turbines, are of the three-phase type and give 750 kilowatts each. These machines work at 2,000 volts, which will be raised to 30,000 volts for the line by step-up transformers. If the present project is carried out the plant will rank among the largest in Italy.

Messrs. Commelin and Viau have obtained a patent in France for a constant high-voltage battery which works on closed circuit and can be easily renewed. The elements of the battery are peroxide of lead for one pole and metallic cadmium for the other, in an electrolyte of dilute sulphuric acid. The peroxide of lead is used in the form of plates, while the cadmium, which is contained in a perforated lead basket, is placed in the cell when it is needed for use. The cell is hermetically closed and contains a ten per cent solution of sulphuric acid. To renew the battery, the cadmium sulphide is emptied and the battery washed out with water. The cell is then refilled with the sulphuric acid solution and the lead basket filled up with a fresh supply of cadmium, in the form of small pieces. This form of cell is said to work very successfully.

Preparations are being made for an international traction congress which will be held at Vienna in 1904. The congress relates especially to the subject of traction upon short lines of railroad, and electric traction will naturally occupy a prominent place. The first congress of the kind was held at Paris in 1900, and a second in London in 1902. The principal subjects for discussion at the present meeting have already been decided upon. Among the leading questions are the advantages and disadvantages of electric traction upon short railroad lines, also the kind of current and the voltage to be used. Other questions relate to the economy of operating such lines, the use of motor cars and trailers in city tramway systems, etc. A number of communications on such subjects are expected from leading engineers.

An automobile postal wagon has been built for the Munich post office by the Schuckert Company. It carries a 1.5-horse-power motor which works at 1,200 revolutions per minute. The motor drives the rear wheels by a double reduction gearing and differential. The storage battery consists of thirty cells of the Tudor pattern, which are contained in a box in the

rear of the wagon. A large box for the mail occupies the rest of the space. The total weight of the automobile is 1,750 pounds, and it carries a net load of 250 pounds. The average speed is ten miles an hour, and the automobile is expected to cover sixty or seventy miles in a day's run. The controller gives five positions for the forward movement, two for the rear, and two for the electric brakes. The expense of running is estimated at $0.011 per mile.

The leading manufacturers of electrical apparatus in Russia are taking steps to secure an increased consumption of home products and diminish the imports from foreign countries. At present a large quantity of imported electrical apparatus is used in different parts of the country, to the detriment of the manufacturing interests of Russia. In the hope of diminishing the imports a petition has been addressed to the Minister of the Interior and the Minister of Finances at St. Petersburg by fourteen of the leading establishments, including the metallurgical, machinery and electrical interests, and representing a total capital of $125,000,000 and 76,500 employés. In this petition the government is asked to require the municipalities of St. Petersburg and Moscow to order all machinery and electric apparatus from Russian factories. The present petition applies especially to the material which will be used for the construction and extension of the electric tramways in these cities. In this way the manufacturers hope that the municipalities will be obliged to cease importing electrical and other apparatus from foreign houses and that the government will require all future contracts to be awarded to the Russian factories. The result of this movement is awaited with considerable interest. C. L. DURAND.

Paris, October 31.

The research laboratory of physical chemistry at the Massachusetts Institute of Technology, which was recently opened with a staff of eight research associates and assistants and two graduate scholars, working under the direction of Professor A. A. Noyes, H. M. Goodwin and W. R. Whitney, has now in progress, it is reported, numerous interesting investigations, some of which are as follows: "The Electrical Conductivity of Aqueous Solutions at High Temperatures (up to 306 Degrees and Higher);" "The Conductivity of Fused Salts," by Mr. R. Haskell; "Electrical Transference Determinations with Nitric Acid," by Mr. Y. Kato.

FREIGHT DEVELOPMENT BY INTERURBAN ROADS.[1]

BY E. F. SEIXAS.

"The transportation service performed by the railroads includes the movement of freight, the carriage of passengers, and the transmission of mail and express matter. Each of these services merits careful consideration. Whether viewed from the standpoint of public benefit or considered with regard to the volume of business done and profits received by the company, the transportation of freight is the most important service performed by the railroad. The income from the passenger business is about one-fifth of the total income and earnings of the railroads in the United States, while the receipts from the freight amount to seven-tenths. Moreover, the social welfare is more dependent upon cheap and unfettered movement of commodities than upon inexpensive and speedy means of travel; however important it may be that the relatively few people who may at any one time desire to take a journey should be able to reach their destination promptly and comfortably, it is of incalculably greater consequence that producers should be able to dispose of the commodities upon the sale of which their livelihood depends and that consumers should have the power of drawing upon distant as well as near sources of supply for the satisfaction of their wants and the gratification of their desires.

"The volume of freight transported increases rapidly with the progress of civilization and the diversification of men's wants. The freight business is carried on to enable men to secure what they want; and the more complex their demands the more goods will be produced and transported. The growing demand for the freight service has furnished a most powerful stimulus to inventors and engineers to lessen the obstacles to the movement of commodities by improving of tracks, cars and locomotives, and making other changes in the railroad mechanism whereby the costs of transportation have been reduced to their present small amount. Whether the endeavor of railroad companies to increase the speed of their passenger trains or their efforts to lessen the cost of freight movement have been the more potent incentive to mechanical improvements, it would be impossible to say; but the results accruing to society from these improvements have come more largely from the greater facilities for the shipment of goods."

So writes Professor E. R. Johnson in his very excellent review of American Railway Transportation. So much for our friends the steam roads. The conditions that have caused such signal success in the passenger business of interurban lines that depend on electric energy for their motive power are to a great extent responsible for the hearty greeting with which the average shipper, be he merchant or farmer, hails the advent of the trolley, and for the great complaisance with which he views the humming, whizzing cars that frighten his team of colts and send clouds of dust into his wife's otherwise immaculate parlor.

The first condition that tells in favor of the interurban line is the frequent service and the frequent stopping places. The second is that the interurban line is more or less of a local affair, and for that reason is more intimately cognizant of local necessities. In the battle between the piston rod and the trolley pole passenger rates have suffered to a more or less extent, while freight rates have pretty generally remained where they were. The interurban lines have not found it necessary to inaugurate a rate war to get freight business from the steam roads, for they receive and are justly entitled to their proportion of the business on account of the increased facilities.

The present Niagara, St. Catharines & Toronto Railway was originally a steam road, constructed in 1886, and changed to electricity in 1899 and 1900, the first electric car running July 19, 1900, from Niagara Falls, Ontario, to St. Catharines. Prior to the change in 1900 the road had, through poor management and consequent poor patronage, fallen into the hands of a receiver, and was sold by the courts under the hammer, the present stockholders purchasing and converting it into an electric line; afterward extending the line to Port Dalhousie, and establishing communication with Toronto by steamers, which are also owned and operated by the company. A track connection had by the original company been arranged with the Michigan Central Railroad Company at Niagara Falls, Ontario, which has been since maintained, and which affords free interchange of cars to and from all points in Canada and the United States, thus forming a line in competition with the Grand Trunk Railway system in the territory covered by the line and its steamers, for

[1] Presented to the eleventh annual convention of the Street Railway Association of the State of New York, Syracuse, N. Y., October 6-7.

which purposes the original line was intended. The gross annual freight earnings of the line prior to 1900, or during the operation by steam, was less than $20,000, and the freight handled was confined to low classes of carloads, such as coal, this being in fact the principal traffic handled. Very little attention was paid to the higher class traffic, such as package merchandise, and it was not until 1901 that any marked increase was shown. This upward tendency was caused by an energetic and persistent endeavor on the part of the management to increase the development of the facilities which were practically dormant, in taking care of higher class traffic and leaving low class to itself. The methods of handling had to be improved, system organized, and particular attention paid to the despatch of business taken hold of. There was no attempt made to reduce rates, the traffic being carried on exactly the same conditions as steam lines under all circumstances. It was found that accommodation to patrons had a great deal more effect than any benefits derived from useless rate-cutting could afford. Cars are placed at convenient points for shippers to load, they are picked up at convenient hours, and shipping receipts are given at the counter of the business firms by a responsible man who has the freight train in charge, thus saving the customer the trouble and time of going to the railway station to make shipments. All this tended to increase popularity and consequently, by increased shipments, revenue, until for the year ending August 31, 1903, we are able to show an earning of 120 per cent greater than in 1900, and an operating expense of fifty-two per cent as against a previous loss. The package freight must stay with the electric roads, as their methods will, if properly organized, hold it against steam roads, unless congestion is allowed, when the great advantage of quick handling will be lost. The handling of low class freight involves the expense of terminal facilties which in large cities is practically prohibitory, and unless there is assured enough freight to keep a regular competitive service against steam fully alive, it is better that electric roads confine their business to the higher classes of package merchandise. With us it is found also that switching service is a source of revenue which if facilities are available is remunerative, we having arrangements to switch loaded cars to and from the Grand Trunk Railway, our competitor, and industries located on our tracks. This service is easily performed and at a very little expense, the distance usually being short and quickly handled, and it pays because ordinary power is employed at times when we can afford it without detriment to our other interests. There is, in our opinion, ample revenue in the development of freight service for interurban lines provided, as above, that low class traffic is not sought after too closely and only taken care of when it involves the higher classes. No freight can be handled at a profit that pays less than one cent per ton per mile, and even at that figure there is not enough revenue to warrant short haul lines seeking it. To sum up, all that is necessary to make electric lines a factor in freight traffic is seeking high class freight, quick handling, and promptly attending to customers' requests, to secure success.

We have found that working arrangements can not well be based upon a mileage pro rate unless a constructive mileage is allowed the smaller line, and it is not practicable to do this in our case (although conditions with other lines may be different and groupings may be obtained from connecting lines affording a pro rate) because we are a lake and rail line, peculiarly situated, breaking bulk, and our connections do not favor percentage arrangements. We therefore have worked almost our entire traffic on an arbitrary basis, receiving as our proportion on classes one to six under the official freight classification the following figures, *viz.*:

Class ..	1	2	3	4	5	6
Cents....	8	7	6	5	4	2½

per hundred pounds for our haul, whether long or short, and not participating in any reductions made by connections due to competition from various causes. We therefore submit that interurban lines are in a better position on an arbitrary basis than percentage, although the disadvantage of having no voice in rate-making without consent is apparent by reason of non-participation in the reduction of rate asked, but this is only a matter of correspondence, we find, and is generally acceded to readily by connections upon representation of facts. The classes shown above do not cover the low class or commodity traffic which I have alluded to in the first part of this paper, which are carried only by special arrangement between lines interested and generally calls upon the short line to reduce their earnings to merely what it costs to handle, hence the assertion that it is better to leave it alone except where it may carry other higher traffic with it, when it can not profitably be turned down because the manufactured product might be lost, and as this is high class it is profitable. We unfortunately had to take hold of an existing line, with its rates and obligations fixed, and were unable to alter the existing divisions of rates, although we have from time to time endeavored to do so. Initial errors are costly, and upon interchange being arranged care should be taken to have all traffic arrangements thoroughly arranged by competent men, fully conversant with such subjects. The earnings per ton per mile should be fixed as high as possible, and never allowed to be less than what steam lines earn. Short mileage allows fair revenue, such as our earnings being not less than twenty five per cent minimum of through rates, and upon extension of line minimums could be increased correspondingly. Conditions of traffic in Canada differ, however, from the United States in many respects. For instance, we have in large centres cartage to perform which is forced upon us by an old existing arrangement made by the Grand Trunk Railway when it was practically the only line in Canada, and which was inaugurated by it to take care of friends. This is a burden, because the expense is not covered by extra charge made above freight rates, part being absorbed in the rate. Another factor of expense in handling is the freight car equipment which costs interurban lines a per diem rate of twenty cents for every calendar day if foreign lines permit the use of cars. No line should be dependent upon equipment belonging to others, nor should they undertake to do more than deliver on cars at convenient points, unless the circumstances are very exceptional, as every transfer or movement necessarily costs money and increases the operating expenses materially. Rates should be maintained, and although steam roads are liable to cut with a view of forcing the business from electric roads, the public soon find that the competitor is being neighborly enough to try such tactics to force the electric road out of the business and then put up its rates with all the old disadvantages of slow time and poor service, that they will not patronize the line adopting such practice. Another commanding advantage to interurban lines is that their business is done on main roads in a number of cases where there are no terminal expenses, unless they endeavor to enter into active competition with steam lines, when terminals must be provided.

The handling of fruit is an important item in our season's business, Toronto being the central market. To handle our heavy freight traffic with the quickest des-

patch at a minimum cost has brought us to a point of efficiency whereby we find it necessary to allow our boats only thirty minutes at terminal points to load and unload from five to seven carloads of freight. To meet the requirements of our traffic we built a number of four-wheeler platform trucks, the platform of which is similar to express trucks seen on steam lines, and capable of carrying two tons. On these we load all merchandise and package freight, ready to run aboard the boat on her arrival. The freight she brings in is run from the forward gangway, and the freight for her is run in the after gangway. To handle our fruit traffic with despatch we have erected at points along the line fruit platforms, on which we keep a supply of these trucks. The farmer drives to this platform, loads his fruit on the trucks, and this is picked up by our fruit train, which consists of flat cars the same height as the platforms, and are run to make connections with each boat. This train is manned with three men who run the loaded trucks from the platform on the cars. At Port Dalhousie they are run directly from the cars on the boat. This prevents handling, which is very damaging to the fruit, and also permits the fruit-grower to use a cheaper grade of baskets, thereby effecting a great saving for him.

On the whole, therefore, freight business of interurban lines will pay if confined to the higher class of traffic and particular attention is paid to despatch and accommodation to the public.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CLXXI—ON X-LIGHT TUBES IN WHICH AN INTERNAL TARGET IS COOLED.

Several makers have adopted the plan originated during these experiments of cooling an internal target in an X-light tube, but owing to want of experience they have failed to copy the more efficient types, making inferior forms of the earlier and less valuable, in which the target was cooled by a small reservoir of water attached to the X-light tube, instead of by a constant discharge of air or water against the target. The tube illustrated in Fig. 1 is a type of what a water-cooled tube should not be. It is selected because in the most recent work on X-light this statement is made in regard to it, "Of the water-cooled tubes this is unquestionably the most effective."

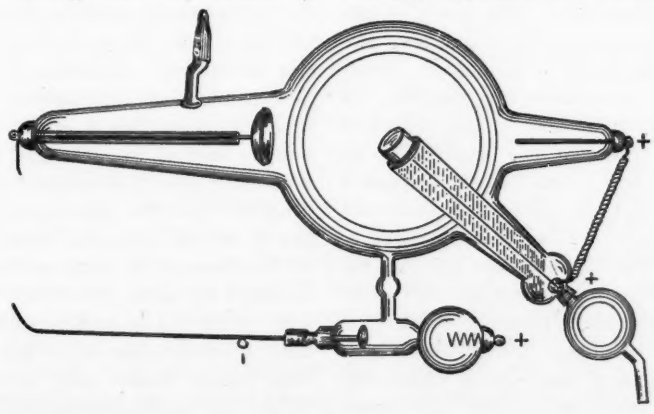


Fig. 1.

When this tube is excited by a powerful current the water is driven from the target, which the heat then melts, or the tube cracks at the seal. A second objection to this tube is the impracticability of sending the X-light in some of the required directions. No tube is suitable for medical use unless the X-light can be sent up, forward or down at any angle. With this tube the light can not be conveniently thrown upward, as it should be when examining a patient in a horizontal position with the source of X-light below, because the cooling liquid falls away from the target by gravity, allowing the target to heat. If manufacturers of cooled target X-light tubes do not wish to adopt the plan shown in note i of using an air or liquid stream from a source outside the tube, they should copy the idea used in the earlier forms of this tube, for, as shown in Fig. 2, it allows the X-light to be sent in any direction, as the cooling attachment being attached to the tube by a rubber or oak bark stopper permits the reservoir to remain vertical while the tube is turned about its long axis to cause the light to shine up, forward or down at any angle. When electrolytic breaks are used with coils of the type shown in earlier notes, in which a large amount of current can be safely employed, even the better type of cooled target tube illustrated in note i may require a different arrangement of the cooling devices, if this is a liquid, to diminish the risk of injury to the seal. In some of the later forms the hollow target was made longer, the glass and platinum at the seal being kept at a more uniform temperature by the arrangement shown in Fig. 3. This modification is not required when the target is cooled by an air blast. Some of the experiments have shown the possibility of producing X-light of proper quality in sufficient quantity to show the heart clearly at a distance of ten metres with a current which does not melt a thin uncooled platinum target. Generally a current is used sufficient to convert into vapor the water touching the target, which then melts, admitting air to the tube. The way to prevent this is to discharge the cooling agent in a constant stream directly against the target. Cooled target tubes in which this is not done are not better than those with rotary uncooled targets, such as have been shown in these notes.

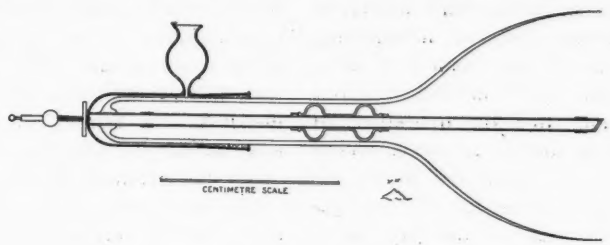


Fig. 2.

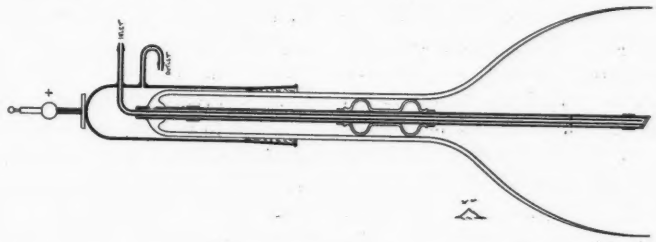


Fig. 3.

Reviews of Current Engineering and Scientific Literature.

Methods of Measuring Radiant Efficiencies.

It is important in the work of increasing the efficiency of our illuminating agents that an accurate method of determining the efficiency be devised, or, if this is not possible, that the limitations of the methods at present in use be understood. Dr. E. L. Nichols and Mr. W. W. Coblentz have investigated the methods now relied upon, and in this paper show that they are far from accurate. The most general method of determining the efficiency of an illuminant is to measure the total radiation, and then, by interposing a screen which is supposed to cut off the heat rays without seriously reducing the luminous rays, to make another determination. The latter is supposed to be proportional to the luminous rays, and the ratio of this to the first is taken as the light efficiency of the illuminant. The screen most often used is a glass cell filled with pure water, but this does not stop all the heat rays. An alum solution has been used instead of water, but it has been shown not to be as satisfactory as water. Another method is to determine the radiation in the various parts of the spectrum. The radiated energy is then completed by integrating the curve thus obtained. In this method the readings are affected by the width of the spectrometer slit, and correction for this is difficult. Another method is due to Angström, who separates the infra red radiation by interposing an opaque screen in the spectrum, after which the light is reassembled and its energy compared with the total. The authors reach the conclusion that, for satisfactory measurements, recourse must be had to a method based on the principles used by Angström, or a satisfactory screen must be found.—*Abstracted from the Physical Review (New York), October.*

The Central Station Battery.

In the opinion of Mr. R. W. Vicarey, storage batteries are not receiving as much attention as they should from the technical press. Storage batteries are important adjuncts to central station equipments, but they seem to suffer from lack of care, due, doubtless, to insufficient knowledge on the part of the attendants. The demands of a central station vary within wide limits, and it becomes extremely difficult to design and construct a battery which will be uniformly durable and efficient inside such limits. This fact makes the battery somewhat more delicate than it would possibly be otherwise. While a battery may not need skilled attention, yet it needs ordinary and regular attention, just as any other part of the plant installed. Mr. Vicarey believes that voltage readings of cells do not indicate as surely the condition of the cell as determinations of the specific gravity of the acid. By this method a sick cell can be detected readily. Specific gravity readings are equally as important in making tests of storage batteries. In fact, the author prefers such readings to those of voltage. Even a partially short-circuited cell will sometimes give its normal electromotive force while charging, and thus make it difficult to detect, but specific gravity readings will always indicate trouble in any cell. Temperature readings are also important, and the temperature of the room should always be given when reporting upon a test. When a cell is found to be sick, it should be examined at once and the cause removed. If there should be nothing apparent to indicate the reason for its behavior, an analysis of the electrolyte will, no doubt, supply the information required, and in all probability save the cell from being ruined.—*Abstracted from the Electrical Review (London), October 23.*

A New System of Simultaneous Telephony and Telegraphy.

This is the first paper by M. Turchi, describing the system of the simultaneous use of a line for telephonic and telegraphic transmission. The principle involved is that of designing a telephone apparatus that will not respond to the certain frequency employed in sending telegraphic messages. The theory of this principle is first considered and nine possible arrangements of condensers, resistances and inductances are analyzed. A divided circuit is used, in each branch of which is connected one winding of an inductance coil. One branch contains a condenser and the other a condenser and an inductance, the two branches being so adjusted that the currents through the two windings will neutralize each other at that particular frequency which it is desired to suppress. The divided circuit forms part of a local circuit which contains the telephone receiver and transmitter and the necessary ringing apparatus. Connection with the transmitting line is made through a transformer. The calling apparatus is operated by rapid impulses sent over the line from a small induction coil. The current for the transmitter is furnished from storage batteries. The system has been tried over iron lines ninety kilometres long, and over bronze lines 318 kilometres in length. Tests were made in connection with various telegraphic systems with success. The apparatus is so designed that the condensers and inductances can be adjusted to the particular line on which they are installed. This system also provides against disturbances due to parasitic currents such as might be caused by a neighboring trolley line.—*Bulletin of the Association des Ingenieurs Electriciens (Liege), September 30.*

The Compensation and Compounding of Alternating-Current Generators.

A recent paper by Mr. Alexander Heyland, on the compounding of alternating-current generators, calls forth some criticism from Mr. H. S. Meyer on this method of excitation. In considering the question of first cost, Mr. Meyer does not believe that the new type of generator can be built more cheaply than the old and standard type. The diameter of the armature is chiefly determined by the number of poles, leaving only the width for a saving, and he does not believe that much can be gained there. The cost of a commutator with cross-connections must be set against that of the exciter for the standard machine. For ordinary high-speed machines there may not be much difference in the cost of these two items. For slow-speed machines the conditions will be more unfavorable to the Heyland machine. The cost of operation involves the question of efficiency and attendance. But little can be saved by increasing the efficiency, since in modern machines having an inherent regulation of about six per cent at full non-inductive load, the total excitation should not be more than one per cent of the output of the generator. In regard to attendance, it is hardly probable that the switchboard attendant can be entirely done away with. The cost of maintenance for both machines should be about the same, while the cost for reserve parts will be greater with the Heyland machine than with the standard. The author thinks that self-excitation, except for small machines of few poles, is a step backward, particularly as an initial impulse has to be given before the machine will excite itself. Automatic regulation of the voltage is undoubtedly

of great value in small plants with lighting and power loads. Here the standard generator can not economically be built for a close regulation, and the attendant, who is at the same time in charge of the engine, can not give the necessary attention to the regulation of the voltage. In larger plants the fluctuations can be taken care of by the switchboard attendant. The author thinks that if automatic regulation is desired it can be obtained in a satisfactory manner in any standard generator, and he describes a system recently brought out by the British Thomson-Houston Company, in which a relay rapidly opens and closes a circuit, shunting the rheostat in the exciter field. The relay is controlled by the voltage of the alternator, and it will act immediately on any change of voltage, whether it be caused by non-inductive or inductive load, or a drop in the speed of the engine.—*Abstracted from the Electrician (London), October 16.*

Technical Education—What It Should Be.

In this article Dr. Louis Duncan first studies briefly the condition of technical education in the important commercial countries; and second, gives his notion of the position of technical education in the United States, its difficulties, its mistakes and its possibilities Technical education in Germany combines with the painstaking acquirement of knowledge typical of German education an idea of research. In America it is the old-fashioned general collegiate education modified by paying special attention to technical subjects, with a veneering of manual training. In England to-day it is chaotic, with a tendency to keep it on a trade basis. The aim of technical education is to apply discoveries to practical work. When a new problem comes up it is attacked from the point of view of a few general principles. The fault of technical education is, in America, that it is too technical and that there is too much instruction. We should not attempt to make mental storehouses of men, but mental factories. The ability of a man to work out any specific problem depends on his being able to make a mental plot of the problem and keep it constantly before him. This requires an imagination that has been developed, and not suppressed. The successful engineers are those who can see the problem as plainly while they are walking on the street as they can see it on the blue-print. Our largest and best-equipped institutions do not show as fair a percentage of leading engineers as some of the smaller, poorly equipped colleges. This is due to two things: first, the larger institutions have presented courses including more instruction than can be given in smaller institutions; second, in the smaller institutions the students are more directly in contact with the instructors, and as they do not have many facilities for work, when an experiment is to be tried, the ingenuity of the student—and not his patience—is exercised. To sum up, Germany is supplying a magnificent basis for engineering research, but is weak in the application of this research. In England there is a tremendous gap between Thomson's theory of electrons and instruction in wood-turning. Here in America we have crowded into twenty years of commercial development the results of two centuries of the world's research, but we are now nearing the end of the researches which we have appropriated, and we must soon either lay down fresh foundations or stop building.—*Abstracted from the Engineering Magazine (New York), November.*

Timber-Treating Plants.

Five years ago when Mr. W. W. Curtis began to write on the treatment of railroad ties, interest in the question was largely academic. He now estimates that during the twelve years preceding 1899, 10,000,000 ties were treated. To-day there are sixteen works in operation, furnishing ties to fifteen or more railroads. Probably more ties will be treated during this year than during the twelve years preceding 1890. At first it was thought advisable to treat only the best ties, thus adding to the expense of treatment the higher price for the finest ties. Now inferior ties, which would ordinarily give a short life, and are therefore cheaper, are equal to the best when treated. Three methods of treating are discussed. In the first method zinc chloride is injected, and where the work is carefully done a tie of soft lumber will have a life equal to that of white oak. In treating the tie, the climate to which it will be exposed should be considered. If it will be exposed to much water, great care should be taken to dry it thoroughly before using it, to prevent bleaching out of the zinc chloride. If water is left in the tie, the chloride is easily washed out. The second method described is the zinc-tannin treatment. This was begun about twenty-five years ago. The tie is treated with chloride of zinc, the glue and tannin forming an insoluble compound, preventing the loss of the zinc chloride. Ties treated in this way give good service, but the records are not very complete. The treatment is said to cost about three cents more than the zinc treatment alone. The third treatment consists in treating with zinc and creosote oil, either together or separately. Creosote is the best timber preservative known, but it is expensive. Chloride of zinc is used to decrease the large amount which would otherwise be absorbed by the wood. The creosote may be used alone, but the cost of the material would be excessive. The following are the costs given for the three processes—zinc chloride, 3.75 cents per cubic foot; zinc-tannin, five cents per cubic foot; zinc-creosote, 7.5 cents per cubic foot. For creosote alone the cost is fifteen cents per cubic foot. Timbers which readily take the treatment, and which, when treated, make a valuable tie, include the inferior oaks, beech, hemlock, pine, spruce, fir and probably gum. The author then describes a good arrangement for a timber-treating plant, showing how the installation should be laid out to get the best results.—*Abstracted from the Journal of the Western Society of Engineers (Chicago), October.*

A Plea for Better English in Science.

In the current issue of *Science,* Mr. P. C. Warman makes an earnest plea for better English in scientific and technical publications, from which we excerpt the following paragraph:

Scientific men, especially the young men, are prone to spend most of their time in observing and experimenting; comparatively little is devoted to studying the accumulated data and their relations, and little indeed is reserved for composition. Phenomena are sought with eagerness, but, once discovered, interest in them wanes. The field and the laboratory are too alluring to be resisted for long, and the time to be devoted to reflection and to writing is minimized. Neglecting what Coleridge termed "ratiocinative meditation," they produce with facility papers consisting of crude raw materials which can but repel persons endowed with a sense of order, strength and beauty. Doubtless these writers are, as Henry James says, "strangers to the pangs and the weariness that accompany the sense of exactitude, of proportion and of beauty," but in many cases it is also true that they are writers who "have been hindered in their course and never knew the reason why." I appeal to the scientific men of America, especially the younger men, to cast off this shameful indifference to the power and beauty of their marvelously rich and adaptable language, and to devote to their writing some of the energy they manifest in the field and some of the patience they exercise in the laboratory.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Motor Starters.

The accompanying illustrations show the motor starters manufactured by the Ward Leonard Electric Company, Bronxville, N. Y., conforming to the United States Navy specifications.

The two levers are pivoted on the same pivot, one lever being that of an ordinary spring-operated positive-release circuit-breaker, and the other arm is provided with the operating handle which has the no-voltage release which brings the starting arm to the off position from any running position on failure of voltage.

The resistance wire or ribbon is composed of high-grade nickel alloy, and is embedded in and held against movement by solid mineral insulating material, such as enamel or silicious sand. This nickel

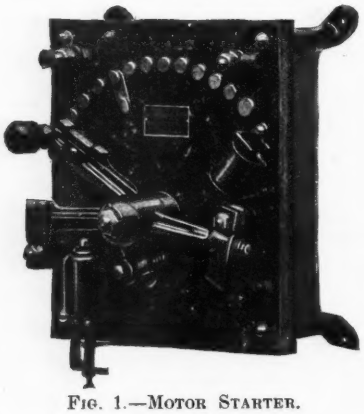


FIG. 1.—MOTOR STARTER.

alloy does not corrode and does not materially increase its resistance with rise of temperature. The insulating material used, either enamel or silicious sand, is non-combustible, non-absorbent and non-damageable by moisture or by heating to 300 degrees centigrade. This resistance is so supported that it will not become displaced or fall out in case it should be melted off or overheated in any part. These characteristics are the special features which conform to the specifications as issued by the United States Navy Department. A bulletin recently issued by the Ward Leonard Electric Company details these specifications and also details a few of the claims in the patents awarded to H. Ward Leonard, showing wherein the specifications and the claims are similar.

Fig. 1 shows the SKE type of motor starter. Fig. 3 and Fig. 4 show a motor panel which the company is building for the government and for motor manufacturers who are building variable speed motors, the speed variations being obtained by varying the field strength. Fig. 2 shows a diagram of the connections of this motor panel.

The experience of the oldest workers in this branch of electrical engineering has shown that at least ten points of field control are necessary to give proper regulation and to prevent jumps of speed be-

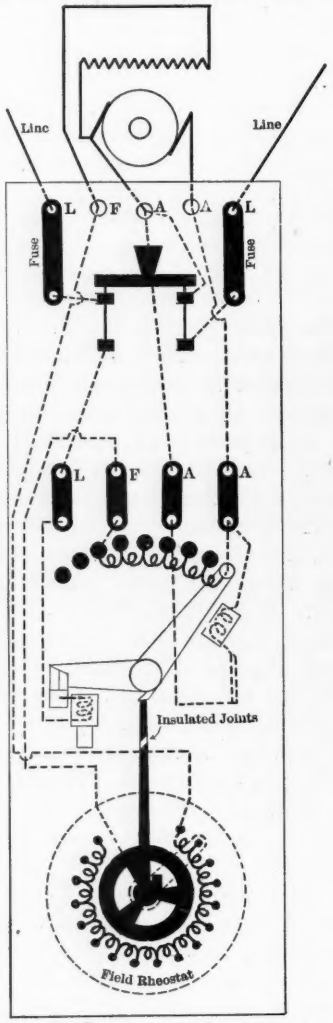
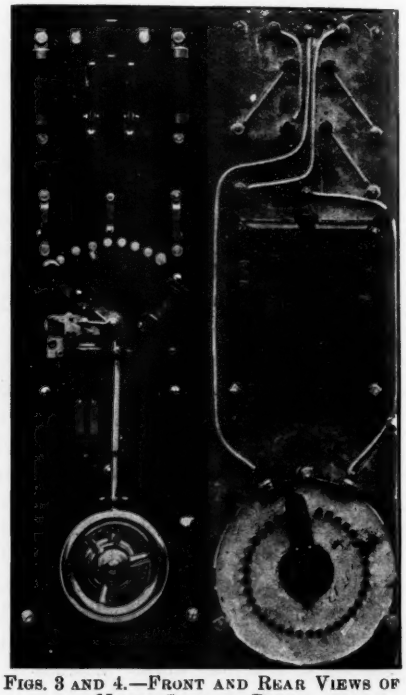


FIG. 2.—DIAGRAM OF CONNECTIONS.

tween points. The accompanying illustration of the panel shows that it consists of a motor starter so interlocked with a field rheostat that the motor can not be started under conditions of weak field. This prevents the possibility of overloading the armature in starting with all resistance thrown in on the rheostat, and therefore a very weak field. This rheostat may have anywhere from 30 to 150 steps, and gives the most perfect and even speed regulation. The no-voltage release magnet is independent of the amperes flowing through the field, and therefore will not release the arm of the starter upon weakening the field current. The starter is equipped with an independent interlocking overload circuit-breaker which protects the motor at all times, even during the period of starting.

The illustration will also show the simplicity and freedom from fire risk of this apparatus, as well as its freedom from any chance of short-circuit or destruction due to rust. The resistance of the starter



FIGS. 3 AND 4.—FRONT AND REAR VIEWS OF MOTOR STARTER PANEL.

and the field rheostat has a practically zero temperature coefficient.

No iron or copper resistance is used in the construction of any of the apparatus manufactured by this company. The United States Navy uses this type of panel in large quantities.

Electric Automobiles.

The accompanying illustration shows an electric automobile runabout manufactured by the Studebaker Brothers Manufacturing Company, of South Bend, Ind. This type of vehicle has been on the market for some time now, and while the manufacturing company, which is one of the oldest and most prominent builders of horse-drawn vehicles, could well be re-

lied upon to produce a carriage satisfactory from a carriage builder's point of view, the performance of the electric vehicle has been such as to warrant its being placed in the same classification as the company's horse-drawn vehicles.

One of the chief arguments which has been advanced against the universal acceptation of electric power in driving automobiles has been the alleged difficulty of securing facilities for charging the batteries, this making impossible tours of any great length. It is now conceded that, in many parts of the country, there are numbers of charging stations which make a specialty of supplying current to the batteries of electric automobiles, and, in other instances, the ordinary machines found at almost any lighting and power station can be made to do the work by the manipulation of very simple regulating apparatus.

ELECTRIC RUNABOUT FOR LONG RUNS.

A noteworthy trip made with one of these Studebaker electric automobiles was undertaken by Mr. Peter Dumont, of the New York automobile department of the company, and his wife. They made a very successful two weeks' tour without a single mishap. The parties left their home at Cranford, N. J., on September 1, in a Studebaker model No. 1354 electric runabout, selecting the heaviest sections of New Jersey and eastern Pennsylvania for the trip. Owing to a severe rain-storm just before the trip was commenced, the back country roads were in very bad condition, and there were also a number of very steep grades to be overcome. There was no difficulty experienced in securing charging current, as at every town where stops were made either current was received from the proper apparatus direct, or was taken from the exciting machines, using a water rheostat to regulate the current flow. The route followed took the party from Cranford to Somerville, N. J.; Flemington, N. J.; Doylestown, Easton and Washington, Pa.; Hackettstown, N. J.; and from Hackettstown to Morristown the most difficult bit of riding on the trip was encountered, which necessitated the automobile climbing Schooley's mountain. This is a very steep, long grade, and has proved an impossible obstacle to a great many automobiles. From Morristown the run was made back to the starting point at Cranford, about 300 miles having been covered in all.

The battery used in the Studebaker automobile will give a run of forty miles in one charge. It is located in the rear body compartment, and the motor is hung immediately in front of it. This motor has been especially designed for automobile work, and is built by the Westinghouse Electric and Manufacturing Company. The design is such that small increases in current produce a greater power effect than ordinarily obtains in motors of this class. This cuts down the battery discharges, even in severe service. The motor has been suspended above the springs from the frame of the running gear on which the body rests, and is so arranged that it can be swung backward or forward and fastened rigidly in position, securing perfect chain adjustment.

The power transmission is by roller chain from a countershaft built into the motor head and a balance gear on the rear axle. The pull of the chain is taken by distance rods attached to the side bars of the running gear frame and to the main rear axle bearings.

The controller has four speeds, and its handle is conveniently located at the left-hand side of the seat. The motor reverses by pressing a lever with the heel. The speeds backward are the same as forward, and are equally divided. The highest speed is thirteen miles per hour on a level street.

A cutout switch is provided which can be operated by the foot to throw off the power in case of emergency. It has a removable handle, and the operator can safely leave his automobile standing unattended by taking this out. The same switch, when thrown into the lowest position, makes the proper connections for charging the battery and cuts out all the wiring in the vehicle except that between the charging plug, the switch and the battery. This makes it possible to examine the motor, controller or wiring while the battery is on charge.

The batteries must be charged from some direct-current circuit which will give approximately twenty amperes at a voltage between sixty-five and 115. Each automobile is equipped with a charging receptacle which will fit the standard charging plug.

The automobiles are equipped with indicating meters, showing the condition of the batteries at any time. Two electric side lamps are furnished, operated by switches in the heel board.

The frame of the gear is made of high-grade tubular steel. This is so constructed as to relieve the body of the vehicle of all strains of any nature. The front springs are semi-elliptic, the rear springs fully elliptic. The steering is done by a side lever, which makes the easiest possible control of the vehicle. Two powerful brakes are placed on each

carriage, both controlled by foot levers. One of these brakes operates on two drums placed on the rear axle, the other operates on a drum mounted on the end of the motor shaft.

The front axle is tubular, reenforced throughout its length. The steering spindles are made of high carbon solid steel. The rear axle is a solid bar of steel, running from one wheel to the other and fitted with a short sleeve on one side to get the necessary differential effect.

Either wooden wheels or wire wheels are furnished, as specified. The wooden wheels are of the artillery type, and the wire wheels are made with swedged spokes of high tensile strength. The tires are thirty by three-inch double-tube pneumatic of the detachable variety.

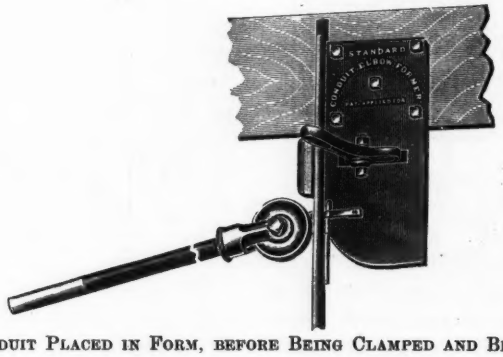
Ball bearings are used wherever they are of advantage. These bearings are extra large size, made especially for automobile use.

The Studebaker Brothers company of New York, Broadway and Forty-eighth street, New York city, is the New York branch of the Studebaker company.

A New Type of Conduit Elbow Former.

The accompanying illustrations show a new type of conduit elbow former invented and manufactured by L. H. Church, 322 Main street, Stamford, Ct. The important feature of this apparatus is the speed with which conduit can be manipulated, and another feature is the absolute accuracy with which the standard elbows

CONDUIT CLAMPED IN FORM AND ELBOW TURNED.



CONDUIT PLACED IN FORM, BEFORE BEING CLAMPED AND BENT.

can be turned, eliminating entirely all guesswork. As may be seen from the illustrations, the apparatus consists of a heavy cast-iron form, which is bolted to one end of the bench, preferably at the end opposite to the pipe vise. A powerful eccentric and lever manipulate a grooved vise jaw, which, after the conduit has been inserted, clamps it against the form, holding it rigidly. The forming wheel is then brought against the conduit and exerts a proper pressure between the grooved wheel and the grooved form, so that the pipe is bent quickly and accurately, without flattening or kinking in any way.

A gauging device is attached to this elbow former, which makes possible the accurate bending of any elbow. Suppose the turn is desired eighteen inches below the upper end of the conduit. Eighteen inches is then measured off from this end, and the pipe is brought up so as to come flush with a mark on the gauge. It is then clamped against the form, and the grooved wheel and lever brought into operation. There are several other ways in which this apparatus can be manipulated, as will be readily understood by any one making any extended use of it.

A large demand is being met for conduit formers of this type every day, as the elimination of made-up elbows and joints is strongly to be desired.

The apparatus is being furnished with interchangeable grooved wheels and vise jaws, so that one-half and three-quarter inch conduit may be taken.

Large-Capacity Electrolytic Generator.

The Holtzer-Cabot Electric Company, Boston, Mass., has paid particular attention to the growing demand for large electric generators of low voltage, but relatively high-current output, for the refinement or reduction of metals by electrolytic action. This company has supplemented its line of platers, which has been very successful for a number of years, with some larger generators designed more particularly for electrolytic work.

The accompanying illustration shows a generator with a capacity of 4,000 amperes at an electromotive force of six volts.

In designing these machines the perplexing problem of commutating the enormous quantity of current was solved by the use of a double armature winding, with two commutators and a special conformation of field.

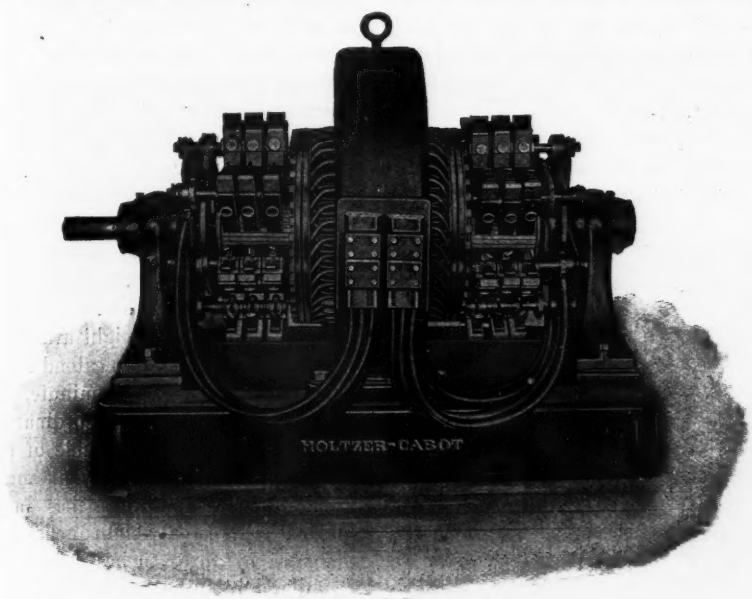
The field ring is of cast iron, and the poles are of wrought iron cast welded into the ring, making an excellent form of magnetic joint. The poles are fitted with a special form of shoe.

The armature core is relatively of quite a large diameter, and is built up of thin discs of soft steel, painted on either side to break up eddy currents. It is mounted upon a spider, the laminations being clamped in a special manner by end-plates, doing away with bolts running lengthwise through the body of the core, thus preventing local currents and reducing heat losses. The spider is provided with a threaded projection which holds the commutator in such a way as to leave an opening between the shaft and the commutator in front. Air ducts are provided in the core, and the air, being drawn into the body of the core and thrown out centrifugally through the ducts and winding, serves to keep the armature cool, notwithstanding the great quantity of current flowing. The cylindrical form of winding is used, making the armature resistance low and permitting of the replacing of a damaged coil without much diffi-

culty. The coils are of bar copper and entirely without joint except where they are soldered to the risers of the commutator.

The commutators are of massive construction. They are made up of hard rolled copper segments, soft mica being used for insulation, and are clamped by bolts in such a way as to entirely prevent shifting of the segments. The section of the copper segments was made unusually large, to take care of heat generated by the flow of the current and the friction of the brushes, and at the same time allow for plenty of wear.

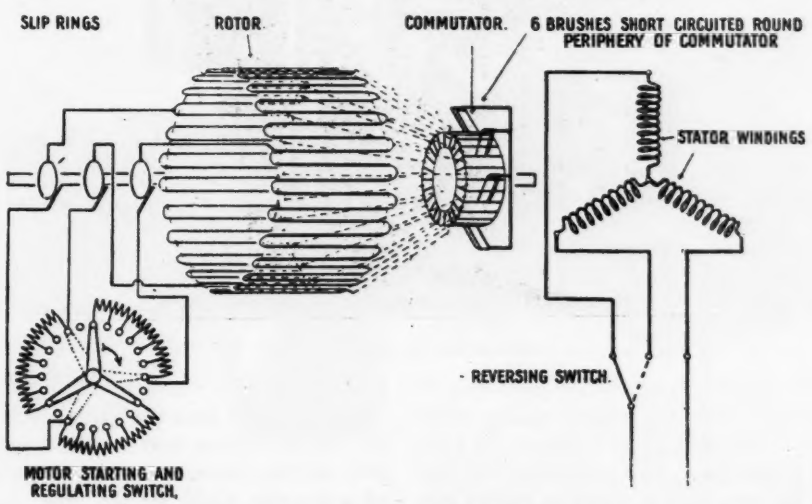
The brush-holder is of the tangent type, such as used on all Holtzer-Cabot platers.



LARGE-CAPACITY ELECTROLYTIC GENERATOR.

A Single-Phase Motor.

A single-phase motor is being put on the market by Ferranti, Limited, of Manchester, England, which is constructed according to the Schueler-Ferranti system. The motor is illustrated diagrammatically in the accompanying drawing. The armature resembles an ordinary continuous-current machine, or rather, the armature of a three-phase synchronous converter, as it has three slip rings in addition to the commutator. The brushes bearing upon the commutator are short-circuited; those bearing on the slip rings are connected together through a regulating resistance. The stator has a three-phase star-connected winding, but only two of the coils are used at one time. The other is put on to make a convenient method of reversing the direction of rotation. As seen from the diagram, by changing the reversing switch, the relation of the two coils in use is reversed, and the direction of rotation will also be reversed. The general idea underlying the design is to combine the properties of the repulsion motor with those of the induction motor, the former giving a large starting torque, and the latter for normal running. In starting, all the resistance is thrown into the rotor circuit, and the motor starts practically as a repulsion motor. As it speeds up, the resistance is cut out and the current thus shunted around the commutator increases until the slip rings are short-circuited. It is said that the efficiency of this motor is practically the same as that of the induction motor. The starting characteristic is nearly a straight line, and it is said that a starting torque of three times the normal running torque is obtained with a current not exceeding twice the normal current; and the normal working current gives a starting torque of twenty-five per cent above the normal running torque.



SCHUELER-FERRANTI SINGLE-PHASE MOTOR.

BOOK REVIEW.

"American Telegraphy, and Encyclopædia of the Telegraph." William Maver, Jr. New York. Maver Publishing Company. Cloth. 566 pages. 7 by 9¼ inches. 490 illustrations. Supplied by the ELECTRICAL REVIEW at $5.

This is a new edition of Mr. Maver's book, which has become a text-book on this subject. The book takes up, in turn, a description of systems, apparatus, and the operation of these. The chapters embrace electrical testing, primary and storage batteries; dynamo machines; Morse, duplex, quadruplex, multiplex, submarine, automatic and wireless telegraphy; burglar-alarm, fire-alarm and police-alarm telegraphy; the printing telegraph; military and naval signaling; railway block systems; telegraph wires, cables, conduits, etc. The author is too well known as an accurate and comprehensive writer on the subject of telegraphy to need more than a passing comment. The book has been before the public for some time now, and the new edition is a worthy successor to the volumes which have been produced before. Each subject is taken up in detail, and where there is liable to be the slightest difficulty in comprehension, the explanation is full and convincing.

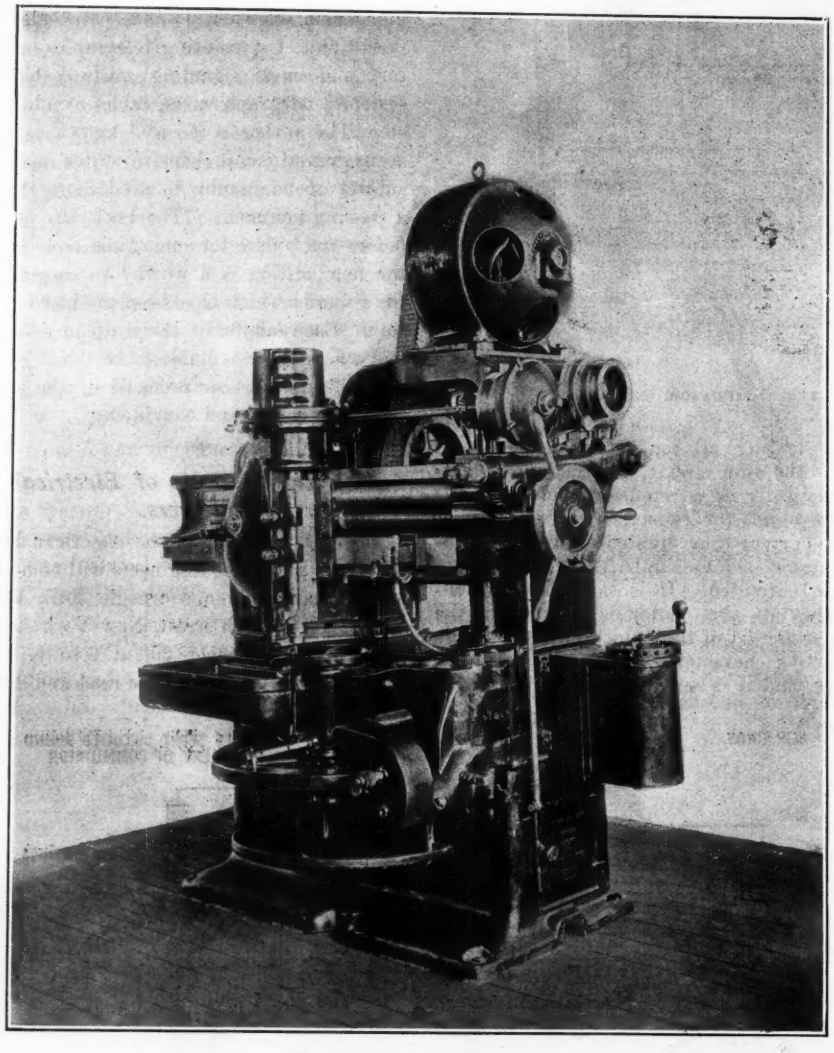
American Institute of Electrical Engineers.

The 181st meeting of the American Institute of Electrical Engineers will be held at the chapter room, Carnegie Hall, 154 West Fifty-seventh street, New York city, on Friday, November 20, at 8.15 P. M. The following papers will be read and discussed: "The Electric Conductivity of Commercial Copper," by Lawrence Addicks; "The Comparative Behavior of Floating and Booster Control Batteries on Fluctuating Load," by Lamar Lyndon.

A Gear-Shaper with Motor Drive.

In the few years that the Fellows gear-shaper has been before the public it has achieved widespread recognition for its merits as evidenced most convincingly by the large number now in use. To-day nearly all shops that engage in gear-cutting to any extent have one or more of these machines, so that it is hardly warrantable to enter here into a description of its details. For the benefit of those unfamiliar with the tool it may be said, briefly, that the shaper differs from the other forms of gear-cutting machinery in that it replaces the rotating milling cutter by a reciprocating tool having the form of a spur-gear. This planes the teeth and at the same time is caused to revolve with the blank intermeshing precisely as its finished mate is intended to. In degree of accuracy this scheme compares with the hobbing method of forming worm-wheels, and also corresponds very closely to it in principle. The cutters for both may be produced with extreme precision, especially for involute gearing, the only type now in common use, as both then depend on generation by straight lines. For instance, a hob is cut as a perfect V-thread, and the Fellows cutter is finished by being caused to roll against the carefully trued face of an emery wheel with a motion simulating that of a pinion tooth against a rack tooth.

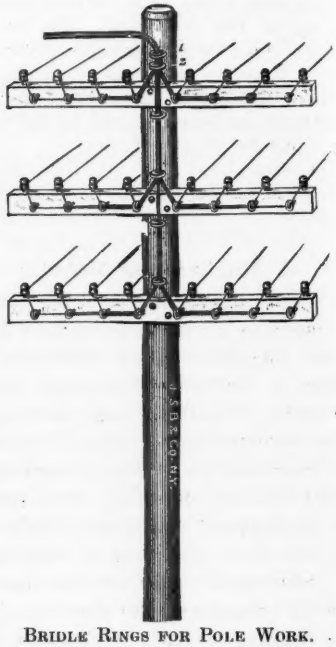
It is the present desire to call particular attention to the machine as now provided with individual motor drive. The only special work necessary was the casting of a plate to span the pillow blocks of the regular driving gear to afford a support for the motor, and the substitution of a sprocket wheel for the cone pulley used with belt drive. With these changes a standard form has been evolved as shown in the accompanying illustration. A five-horse-power Crocker-Wheeler semi-enclosed type motor supplies the power, transmitting it with a reduction in speed through a Renold silent chain to the spindle which normally holds the cone pulley. The speed is further reduced through either of the two regular gear combinations which are used alternately, making two speeds possible mechanically. In addition the motor is supplied with current on the Crocker-Wheeler four-wire multiple voltage system giving it six independent speeds, and with the use of resistance twelve intermediate ones. The upper ten of the motor's eighteen speeds constitute its working range, within which, through the faster gear combination it drives the ram at from ninety-four to forty-five strokes per minute, or with the slower gear combination, forty-three to twenty. The lower eight available motor speeds may be used to extend the range down to six strokes per minute, though twenty is the minimum in ordinary practice. The machine is capable of cutting external gears up to thirty-six inches in pitch diameter by five inches face and internal gears twenty-eight inches in pitch diameter by three inches face, allowing any diametral pitch up to four.



Motor-Driven Gear-Shaper.

Insulated Bridle or Distributing Rings.

One of the most important conditions in installing modern telephone systems is the proper distribution of bridle wire for both interior and exterior service. There is probably no piece of apparatus which can be used with greater facility than a properly designed bridle or distributing ring. Where this apparatus is correctly used it eliminates entirely the tangled and confused network which has brought so



Bridle Rings for Pole Work.

much trouble to telephone companies that have not been far-seeing enough to perceive the justification of the slight additional expense of its free use. The accompanying illustrations show the use of the bridle rings for both house and pole work.

BRIDLE RINGS IN HOUSE WORK.

James S. Barron & Company, New York city, are the manufacturers of the "B. P." insulated bridle or distributing ring. These rings are made of the best quality of iron, heavily coated with tough glass enamel. The wires are readily inserted or removed through openings in the ring, and the enamel prevents rust. The rings are easily screwed in by hand without tools in the most difficult and out-of-the-way places. When desired, they can be unscrewed and used in other positions indefinitely. These insulators are used by some of the largest telephone companies in the country.

A Handy Electric Flashlight.

The accompanying illustration shows the electric flash lamp made by the Eastern Carbon Works, Jersey City, N. J. There are many uses to which these flash lamps are applicable, and it is safe to say that an engineer or electrician would find it an invaluable help in emergencies. There are many conditions about a power-house wherein it becomes dangerous to strike a match or use any form of open flame lamp in case of accident befalling certain parts of the system. This accident may even create a discontinuance of the lighting service so that it becomes imperative to have illumination that the work of investigation may proceed. It is just in such cases as this that the electric flash lamp is of great value.

ELECTRIC FLASHLIGHT.

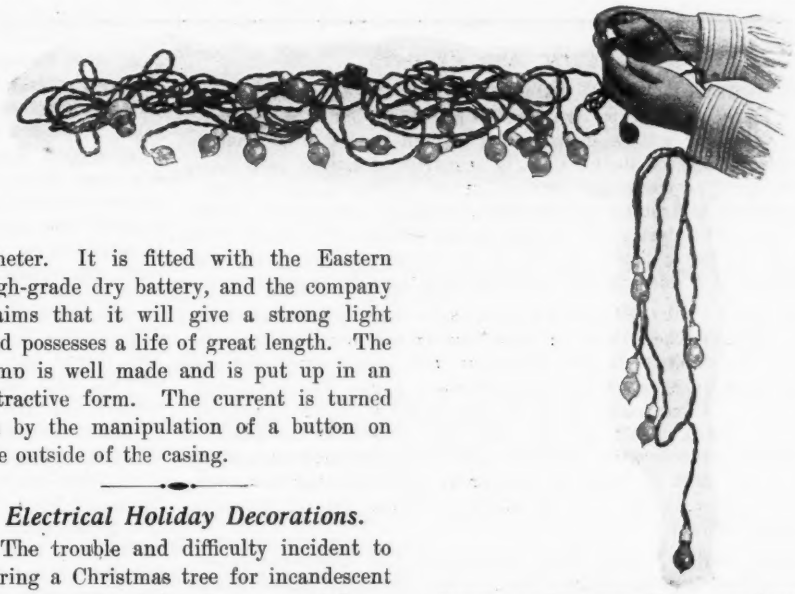
The lamp illustrated is nine inches long and one and one-half inches in diameter. It is fitted with the Eastern high-grade dry battery, and the company claims that it will give a strong light and possesses a life of great length. The lamp is well made and is put up in an attractive form. The current is turned on by the manipulation of a button on the outside of the casing.

Electrical Holiday Decorations.

The trouble and difficulty incident to wiring a Christmas tree for incandescent lamps have heretofore been a great drawback to their use. To remedy this the General Electric Company has prepared an outfit of sockets and cord, connected and completely made up, ready for immediate use. The cord is simply draped over the tree, the lamps placed in their sockets, the connecting plug attached to the nearest electric fixture and the current turned on. All the lamps are instantly lighted and burn without further attention as long as desired. The outfit is light and flexible, thoroughly well constructed and "fool-proof."

FOR INTERIOR DECORATION.

Each regular outfit comprises some fifty feet of flexible cord with tiny sockets, arranged in three branch festoons, and twenty-eight one-candle-power miniature genuine Edison lamps in plain and colored bulbs, sufficient for the average Christmas tree. The outfit is neatly packed in a handsomely decorated wooden box, and forms a safe and charming Christmas gift for any household. Special outfits containing a larger number of sockets for large trees can be furnished when desired. The outfit is of value not only for Christmas trees, but also for general house decoration—upon the table, about the walls or around columns, over the balustrade or from chandeliers—at all times and seasons. An outfit once purchased lasts for years and can be used repeatedly with no trouble or further expense.



METHOD OF INSERTING MINIATURE LAMPS.

CHRISTMAS TREE DECORATION.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

ANOTHER MEXICAN POWER PLANT—A hydraulic power plant is to be built on the San Pedro river, state of Tabasco, Mexico. Power will be derived from the fall known as El Randal. Amalio Acampo, of Mexico City, is primarily interested in the undertaking. The concession granted by the Mexican authorities permits of the utilization of 5,000 litres of water per second. Plans are now being drawn up for submission to the authorities. The sum of $5,000 in bonds, according to Mexican advices, has been deposited as a guarantee for the carrying out of the project.

STREET CAR COMPANIES MERGED—The City Passenger Railway Company, the Altoona & Logan Valley Railway Company and the Tyrone Electric Railway Company have been merged into one corporation, to be known as the Altoona & Logan Valley Railway Company. A mortgage for $4,000,000 in favor of the Equitable Trust Company, of Philadelphia, has been entered in the office of the register and recorder, John W. Cliber, at Hollidaysburg, against the electric lines of the allied companies. The mortgage was given to secure repayment of bonds issued at interest rate of four and one-half per cent.

NEW GERMAN ELECTRIC RAILWAY—The Westhofen-Hohen-Syburg branch of the Hörder District Electric Street Railway was opened to traffic on September 19, 1903. In the spring of 1899 the Allgemeine Lokal und Strassenbahn Gesellschaft in Berlin (General Suburban and Street Railway Company, of Berlin) began, under a fifty years' concession, the construction of a network of street railways in the Hörder district of the province of Westphalia. With the completion of the above-mentioned line it now has 41.02 kilometres (25.49 miles) of tracks, connecting many important industrial towns in the province. The company, which was organized in 1881, owns, controls and operates street railways in different cities throughout Germany. It has a paid-up capital of 15,000,000 marks ($3,570,000) and a bonded indebtedness of 19,000,000 marks ($4,522,000).

INTERURBAN SYSTEM HAS A NEW NAME—In order to avoid the confusion due to the similarity of the names of the Interurban and the Interborough railway companies, which operate the surface and elevated systems in this city, the Interurban Street Railway Company will in future be called the New York City Street Railway Company. An amended certificate of incorporation making the change of name was filed in the county clerk's office at White Plains. The company operates the Metropolitan and Third Avenue systems, which comprise all the surface lines of Manhattan Borough and the Union Railway Company's lines in the Bronx. The amended certificate is signed by Thomas F. Ryan, Frank S. Gannon, Paul D. Cravath, George G. Haven, W. H. Baldwin, Jr., and Edward J. Berwind. The change of name was made on a vote of 77,060 shares of stock. One of the directors said that the filing of the amended certificate was for the sole purpose of changing the name and had no other significance. There have been rumors recently that negotiations were in progress for merging all of the transportation lines of the city, but it was denied that the adoption of a new name for the Interurban was a move in that direction.

MICHIGAN TELEPHONE SALE—The banking firm of N. W. Harris & Company purchased in Detroit, on behalf of a syndicate of the bondholders, the Michigan Telephone Company. The sale was on foreclosure proceedings, and the price $4,100,000. The syndicate represented by N. W. Harris & Company has in it a number of individual New York interests as holders of bonds, the remainder being held in Boston. The issue is for $5,000,000, made in 1897 to run thirty years, and behind it is an indebtedness on notes amounting approximately to $2,500,000, controlled by the American Telephone and Telegraph Company, which, through its constituent company, the Western Telephone Company, owns the $5,000,000 of Michigan Telephone Company stock. Defaulting interest on the bonds, which were secured by a consolidated mortgage, the Michigan Telephone Company went into bankruptcy February 1 last. At the sale the American Telephone Company was the only bidder besides N. W. Harris & Company, their bid being $4,000,000. A representative of a minority stock interest from Boston made protest that the price did not represent the full value of the plant. It has not been determined as yet whether the new owners of the Michigan Telephone Company will undertake the operation of the property or will reorganize with a view to refunding its indebtedness. Plans for subsequent operations are now under consideration.

AN INDEPENDENT TELEPHONE SERVICE IN TORONTO JUNCTION—Negotiations have been completed whereby the Humbert Power and Light Company, which at present provides the electric light and power service in Toronto Junction, will be merged into the "Stark" Telephone, Light and Power Company. The new company has been formed for the purpose of supplying telephone, electric light and power service on the "Stark" system of distribution in Toronto and district. A franchise for twenty years has been obtained from the town of Toronto Junction, and the acquisition of the Humbert Power and Light Company will enable Mr. Stark to proceed at once with the construction of a telephone in combination with the existing light and power service. The agreement with the town provides for the supply of a telephone service within a radius of fifteen miles from the centre of the city of Toronto, at $6 per annum, and one cent per outgoing call, with a maximum charge per annum of $25 for business, and $15 for residence telephones. When, however, the system is in operation in the city of Toronto, with 3,000 subscribers, the maximum charge will be increased to $40 for business and $20 for residence telephones. Three hundred subscribers have already been obtained in Toronto Junction, and the work of construction will be proceeded with at once. The company has also about 3,000 contracts signed in Toronto, and arrangements will be made at an early date for the establishment of the "Stark" system in that city. It is the intention of the company to develop the Humbert water power to an extent which will enable it to supply all the current necessary for a telephone, light and power service in the city and suburbs. The directorate of the new company will include the Hon. John Dryden, president; the Hon. Geo. E. Foster; Mr. J. Blacklock, manager of the Reliance Loan and Savings Company; Mr. H. Waddington, managing director of the London Mutual Insurance Company; Mr. Gideon Grant, of Messrs. Dodds, Grant & Halliday, and the inventor, Mr. Alex M. Stark, who will be the managing director.

NEW CHICAGO TUNNEL COMPANY—Enlarged powers and capital form the basis of a new incorporation of the Illinois Telephone and Telegraph Company at Springfield. The new concern, which succeeds to all the rights and privileges of the old company, is known as the Illinois Telephone Company. It has $30,000,000 capital, against $5,000,000 capital of the Illinois Telephone and Telegraph Company, which was organized and licensed June 23, 1898. For the purpose of incorporating, the new concern paid $30,040 to the secretary of state in fees. According to Albert G. Wheeler, the object of the new incorporation is to get more money for the purpose of building sixty miles more of tunnels under the streets of Chicago, in addition to the twenty miles already in existence. "We have spent $5,000,000 already," said President Wheeler, "and under the new organization we shall spend $20,000,000 more. All our new work will be done under the ordinances which we already have; they are amply sufficient for our purpose, and we shall not seek any new ordinances. We have already installed 10,000 telephones in the business district of the city, and our plans are for the placing of 250,000 instruments all over the city, as well as doing a substreet rapid transportation business. Our bonded power under the old company was exhausted and we made the reorganization for financial reasons primarily." The incorporators of the new company are Charles C. Wheeler, a brother of President A. G. Wheeler; Henry A. Wilkening, an attorney in the service of

the old company, and Thomas A. Moran, Jr., son of the attorney for the company, Thomas A. Moran. According to the articles of incorporation the company has for its objects: "to furnish, transmit, convey and deliver signals, sounds, intelligence, packages, mail matter and general merchandise; power, heat and light by steam, water, air, electricity and otherwise, and to acquire, construct, dispose of, hold, maintain operate and lease to or rent from others all tunnels, instruments and appliances and other property, real or personal, in carrying out such objects." The Illinois Telephone and Telegraph Company was given a franchise February, 1899, under which it has constructed the tunnels now in existence and partly in use. Its capital stock is $5,000,000, and it has out $5,000,000 of bonds, disposed of through its financial agents, J. B. Russell & Company. The bonds are thirty-year five per cent gold securities. The officers of the old company are: president A. G. Wheeler; vice-president, Clarence D. Simpson; secretary, Edwin W. Gearhart; treasurer, H. H. Brady, Jr.; assistant treasurer, J. C. Law. Under its franchise the Illinois Telephone and Telegraph Company is required to construct at least fifty miles of tunnel within ten years. The twenty miles now built have been equipped forty feet below the street level, the trunk tunnels being fourteen feet high and twelve feet nine inches wide, and the laterals eight feet high by six feet wide. These tunnels are equipped with tracks and equipment for hauling heavy cars at fast speed, with the object of building up a profitable business of freight transportation. The railroad yards and depots have been connected with the tunnel and it is planned immediately to extend the service to the outlying stations and the stockyards. No freight is yet being transported through the tunnels, but it is said by the company's officers that this part of the business will begin on or before July 1 next.

OBITUARY NOTICE.

MR. WILLIAM LUKENS ELKINS, the traction magnate and financier, died at his summer home, "Ashbourne," near Philadelphia, on the evening of November 7, of a complication of diseases. Mr. Elkins was born near Wheeling, W. Va., on May 2, 1832. He was educated in the public schools of Philadelphia, and engaged in the commission business. In 1862 he disposed of a good business and invested all of his capital in the oil fields of Pennsylvania, for twenty years being one of the leaders in organizing companies for the oil trade. He built a large refining plant and obtained control of the sale of illuminating oil for Pennsylvania. Other refineries in various sections of the state were also established by him, and in 1875 he became a partner in the Standard Oil Company, disposing of all his oil interests in 1881. The work for which Mr. Elkins was most widely known was in connection with developing and building street railways. He became a power in this direction, and ranked with the leading financiers of the country. In 1873 he invested heavily in the street railways of Philadelphia, and in a few years succeeded in consolidating all the lines into one large company. His first work in this line was the formation of the Philadelphia Traction Company, which acquired possession of the greater part of existing lines; and this work was completed with the formation of the Union Traction Company, which includes every street railway in Philadelphia, one of the largest and best-equipped in the country. His success in Philadelphia led him to reach out for other cities, and he became identified with the street railway systems of New York, Chicago, Baltimore, Pittsburg, Washington and other large centres of population. He was a director of the Metropolitan Traction Company, of New York; the Baltimore Traction Company, of Baltimore; the North and West Side and United Traction companies, of Chicago, and the Consolidated Traction Company, of Pittsburg, and he was also a large stockholder of the North Jersey, Pennsylvania, Philadelphia & Erie, Schuylkill Valley and Fort Pitt railroad systems. In addition to his railway interests, Mr. Elkins was a large investor in gas and electric light companies, particularly in New York, Philadelphia, Boston and Pittsburg. The United Gas Improvement Company, of Philadelphia, was organized by him, and this concern controls sixty plants in many cities, and supplies all the gas for Philadelphia. Mr. Elkins was a member of the Historical, Genealogical and Colonial societies, of Philadelphia; the Union League, Art and Country clubs, of Philadelphia; Maryland Club, of Baltimore; the Manhattan Club, of New York, and the Chicago Club. On January 21, 1851, Mr. Elkins was married to Maria Louise, daughter of Mr. James Broomhall, of Delaware County, Pennsylvania. He had four children—George W., William L., Mrs. George W. Widener, and Mrs. Sidney F. Tyler.

TELEPHONE AND TELEGRAPH.

SAN BERNARDINO, CAL.—A telephone line is to be built from Dale to Amboy.

LITTLE ROCK, ARK.—A telephone line is to be built from Imboden to Black Rock.

TRENTON, N. J.—The Lebanon Telephone Company intends to extend its line to High Bridge.

DIXON, ILL.—A new thirty-year franchise has been given to the Lee County Telephone Company.

HOUSTON, TEX.—The lines of the Northwestern & Beaumont Telephone Company will be extended.

NEWTON, N. H.—The Exeter Telephone Company has asked for right of way to locate poles in the town.

CALIFORNIA, MO.—The California Telephone Company's line has been sold to J. B. Kemper, of Fulton.

WALTON, N. Y.—A telephone company known as the Masonville Telephone Company has been organized.

BOSTON, MASS.—The Citizens' Telephone Company is making arrangements to extend its service to Meredith.

ONTARIO, ORE.—An exchange will be placed in Ontario as soon as the telephone line is completed at this point.

ALLENTOWN, PA.—A number of residents of Armstrong township have organized a local telephone company.

COLUMBUS, OHIO—Articles of incorporation have been filed for the Queen City Telephone Company, of Cincinnati.

ALLENSVILLE, KY.—The Home Telephone Company, Clarkesville, Tenn., will put in an exchange in this town.

FREMONT, OHIO—The Fremont Telephone Company has increased its capital stock from $100,000 to $125,000.

PEKIN, ILL.—The Forest City Telephone Company voted to increase its capital stock from $5,000 to $20,000.

PERU, IND.—The Peru Home Telephone Company has commenced work on the extension of its line to Peoria.

MANCHESTER, VA.—The Bell Telephone and Telegraph Company has acquired the telephone franchise for this town.

DEADWOOD, S. D.—It is stated that the Nebraska Telephone Company will install a $30,000 exchange within thirty days.

BOONE, IOWA—The Boone County Telephone Company will spend $40,000 in this city in the near future on improvements.

GREENSBURG, PA.—The Bell Telephone Company is erecting new poles in this city and making other important improvements.

DURANT, I. T.—The Chicksaw-Choctaw Telephone Company, of this city, has purchased the line of the Western Telephone Company.

PHILADELPHIA, PA.—The business men of Frederick and Zieglersville will construct a telephone line connecting the two places.

SPOKANE, WASH.—The Interstate Telephone Company has filed a petition for a franchise to run its telephone lines through the county.

COLUMBUS, OHIO—The Crescent Telephone Company, of Leesville, Carroll County, has been incorporated with a capital of $10,000.

LINCOLN, NEB.—The Central Illinois Telegraph and Telephone Company is laying out the route for a new through line to Bloomington.

BATESVILLE, IND.—The Batesville Telephone Company has elected the following officers: A. Bloemer, president; O. L. Newman, secretary; Dr. J. T. Ratcliff, vice-president; William Krieger, treas-

urer. The company decided to put a new line between here and Osgood this fall.

REDDING, IOWA—The telephone line to connect Fall River, Cassell and intermediate points with Redding is now said to be assured.

WILMINGTON, KAN.—The Missouri & Kansas Telephone Company is stringing twenty new lines southwest from Wichita through Mulvane.

FULTON, N. Y.—The Empire State Telephone Company, of Oswego, has let the contract for the erection of a new exchange, to cost $15,000.

SENECA CASTLE, N. Y.—Poles are set for the Seneca-Gorham telephone line between Seneca Castle and the turnpike, and connection will soon be made.

WALTON, N. Y.—Enough money has been raised to build the proposed telephone line from Andes over Cabin Hill to Hamden, and work has been commenced.

BRADFORD, VT.—At a meeting of the West Newbury & Bradford Telephone Company, arrangements were made for the early building of the company's line.

DYERSVILLE, IOWA—The Interstate Telephone Company will extend its lines from Galena to Dubuque and the towns in the southwestern part of Wisconsin.

WINDSOR, N. C.—The town council has granted the Roanoke & Chowan Telephone Company a franchise to establish and operate a telephone exchange in Windsor.

PITTSTON, PA.—A charter has been granted the Northern & Lackawanna Telephone Company, of Fleetville, Lackawanna County, with a capital of $5,000.

NEWBURGH, N. Y.—The Colonial Telephone Company has put in 7,000 additional feet of cable recently, and is now laying a cable from Washington Heights to its central office.

CONNELLSVILLE, PA.—The Tri-State Telephone Company has constructed a line from Scottsdale to Uniontown, and has also in operation a line from Connellsville to Dawson.

HUNTINGTON, CT.—The officers of the new Huntington Local Telephone Company are: President, T. F. Bartlett; vice-president, William Card; treasurer and secretary, D. B. Loverin.

COLUMBUS, OHIO—The Payne Home Telephone Company, of Payne, has been incorporated with a capital stock of $15,000, by C. E. Hyman, J. Woolard, J. W. Venrick and Fred Paul.

PROVIDENCE, R. I.—The sale of the Dixon Telephone Company's system to the Providence Telephone Company gives that company control of all the lines in the state as far as Westerly.

ROCKFORD, ILL.—The Central Union Telephone Company is about to erect a new building at Belvidere, and will also make many improvements to its lines. About $75,000 will be expended.

INDIANAPOLIS, IND.—The Burrows Telephone Company, of Burrows, Carroll County, has been incorporated with a capital of $5,000. The company will operate a line in Carroll and Cass counties.

KEWANEE, ILL.—At a meeting of the Stark Telephone Company the following directors were chosen: E. G. Cole, of Toulon; M. Sparr, of Wyoming; J. H. D. Duncan, of Elmira; F. Price, of Goshen.

COLORADO SPRINGS, COL.—The Colorado Telephone Company is expending nearly $20,000 in additional cable for city use, and is also stringing two extra circuits between the Springs and Denver.

LIVINGSTON, MONT.—The new telephone line between Livingston and Bozeman, which has been under construction by linemen of the Rocky Mountain Bell Telephone Company for over a month, is now completed.

WORCESTER, MASS.—The Conant & Parker Telephone Company has organized and elected the following officers: Clarence Parker, president; Frank Conant, vice-president; Harry B. Parker, secretary and treasurer.

DECATUR, IND.—The directors of the Citizens' Telephone Company have elected the following officers for the next term: Henry Hite, president; J. Baker, vice-president; F. M. Shirmeyer, secretary; Ed. Ehringer, treasurer.

HAMILTON, OHIO—The county commissioners have granted the Willey Elevator Company, of Ross, Ohio, a franchise for the construction of a telephone line in the southwestern part of the county for a period of twenty-five years.

PRINCETON, ILL.—The Bureau County Mutual Telephone Company has been incorporated with its capital stock fully paid up, and has elected officers as follows: J. Stauffer, president; Ed. Swanson, secretary; J. L. Martin, treasurer.

HOUSTON, TEX.—The Northeast Texas Telephone Company, of Sulphur Springs, has been incorporated with a capital stock of $50,000. The company will operate in the counties of Hopkins, Franklin, Delta, Hunt, Rains, Wood and Upshur.

ROCHESTER, N. Y.—The Dundee & Tyrone Telephone Company has been organized, and the following board of directors elected: Philander S. LaFever, Fred Kendall, Eugene U. Bigelow, T. N. Howell, Frank Yost, D. S. Crawford, Charles Losey, E. D. Backer, G. A. Motham.

MONTPELIER, VT.—The Vermont Telephone and Telegraph Company has completed another farmers' line extending through the town of Berlin *via* Berlin Corner, nearly to the Williamstown line. Work has also been begun on another subscribers' circuit to East Montpelier, Plainfield and North Montpelier.

AMITYVILLE, N. Y.—The village board of trustees has granted to the New York & Long Island Telephone Company a franchise to construct and maintain an independent telephone system through the corporate village limits. The terms of the franchise require that a portion of the wiring be placed underground.

FORT WORTH, TEX.—A charter has been granted to the Reservation Telephone Company, of White Eagle, with a capital of $5,000. The incorporators are G. L. Miller, of Bliss; W. Carson and R. S. Steel, of White Eagle; R. M. Bressie, G. H. Brett and J. P. Souligny, of Ponca City; W. H. Vanselous, of Blackwell.

JOHNSTOWN, PA.—The Huntingdon & Clearfield Telephone Company has authorized the construction of a line from Clearfield which will take in Mahaffey, Glen Campbell, Arcadia, Barnesboro, Hastings, Spangler and Carrolltown. It is expected that the company will give service to Pittsburg and possibly Philadelphia, *via* Johnstown.

HAMLIN, N. Y.—The Hamlin Rural Telephone Company has been organized with the following officers: D. R. Singleton, president; Charles Basse, treasurer; H. F. Newman, secretary; Chris Rath, T. O. Swanson, B. J. Snook, James G. Barry, D. R. Singleton, Charles Basse and H. F. Newman, directors. The company will install a first-class telephone system.

NEW BEDFORD, MASS.—The Southern Massachusetts Telephone Company has decided to install a common battery switchboard of the latest type in place of its present equipment in this city. The company estimates that the proposed change will involve the expenditure of from $60,000 to $75,000, and it will probably be a year before the work will be completed.

ALBION, N. Y.—The Rural Telephone Company, which started northwest at or near Lyndonville, in this county, has extended its area, and has been so successful in its operations a reorganization has been decided upon. A sale has been made to a new company known as the Lakeside Telephone Company, with $100,000 capital. The company's lines will soon cover all the territory between Olcott and Brockport and, it is said, will eventually become a part of the independent trunk line in this state. The company has given a mortgage for $40,000 to the Rochester Trust Company, to secure funds to continue the work of construction in this county.

ELECTRIC LIGHTING.

COLUMBUS, OHIO—The Mt. Victory Electric Light Company has been incorporated with a capital of $10,000.

FLORENCE, NEB.—The council has passed an ordinance granting a twenty-five-year franchise for an electric light plant.

CONCORD, N. H.—Articles of incorporation have been filed by the Greenville Electric Light Company. The capital stock is placed at $2,000.

YORK, PA.—The Edison Electric Light Company's new contract with the city provides that lights shall be furnished at $40.15 per light per year.

LAKE CITY, MICH.—The machinery for the new electric light plant for this village has arrived, and it is expected that the plant will be in operation in about a month.

OMAHA, NEB.—The Electric Light Company, which was recently granted a franchise and a contract for street lighting in Florence, has begun the work of extending its wires to that city.

SARANAC, MICH.—The village board has granted D. G. Hahn, of this place, a thirty-year franchise for electric lights, and made a contract with him to light the streets for ten years commencing December 1.

FREDERIC, WIS.—The village council has passed an ordinance granting Frank McDonogh, of Eau Claire, the right to begin work on an electric light plant, and also contracted for lighting the streets for five years.

STREATOR, ILL.—It is stated that the Streator Street Railway Company will install an electric light system in this city. All the preliminaries have been arranged, and the work will be pushed as rapidly as possible.

WASHINGTON, D. C.—The Universal Light and Power Company has been incorporated by Robert K. Van Mater, Ralph Wormelle, Edwin L. Bradford and Leonard A. White. The company has a capital of $750,000.

NASHUA, N. H.—The property of the Milford Electric Light Company has been sold. It was bid in by an agent for the bondholders for the sum of $53,800. It is stated that the majority of the bondholders are Boston parties.

RALEIGH, N. C.—The Yadkin River Electric Power Company has been incorporated with an authorized capital of $5,000,000. The object of the company is to develop the water power of the Yadkin river in the counties of Montgomery, Stanley, Davidson, Rowan and others.

WOONSOCKET, R. I.—The Uxbridge & Northbridge Electric Company is installing a new 250-horse-power engine, and a new 150-kilowatt direct-connected alternating generator is also being put in. The company is putting up a new line to Douglas, and the new machinery will be used to furnish the power.

SOUTH BEND, IND.—The South Bend Electric Company has been awarded a ten-year contract for street lighting, beginning with January 1, 1905. It will require about one year to install the system. Enclosed alternating arcs will be used, and the electric company is to furnish everything complete, including iron poles and other equipment. The bid was as follows: arc lamps suspended in the centre of the street, $78.75 per year; arc lamps suspended from iron poles, with wires underground, $95 per year; with wires overhead, $83 per year; incandescent lamps, fifty candlepower, $32 per year.

MARSHFIELD, VT.—It is stated that a large central plant to develop power for manufacturing purposes from Molly's brook and Peacham lake is proposed by P. T. Kelley, of Whitefield, N. H., who has leased the privileges of the Molly's Falls Electric Light and Power Company for a long term. In addition to the Molly's Falls property, Mr. Kelley has secured options on all the available property suitable for reservoir purposes on the entire length of Molly's brook, together with additional rights which will permit the raising of Peacham pond. According to present plans about $60,000 will be spent immediately in developing the privileges. It is the intention of the promoters merely to furnish power for manufacturers in the vicinity.

ELECTRIC RAILWAYS.

SEATTLE, WASH.—Right of way for an electric street car line through the Fort Lawton military reservation has been granted to the Seattle Electric Company.

EVANSVILLE, IND.—The promoters of the Mount Vernon and Evansville Traction line state that the work of acquiring the right of way between the two cities has been completed.

JACKSONVILLE, ILL.—The contract for the construction of the Jacksonville & Concord Railway has been let, and the work will commence at once, with the intention of completing the road by January 1, 1904.

ASHTABULA, OHIO—Ashtabula county commissioners have granted a fifty-year franchise for an electric line from Geneva to Meadville, Pa., by way of Harpers Field, Austinburg, Denmark, Pierpont and Linesville.

PAPILLION, NEB.—L. C. Hurd, representing the Omaha, Lincoln & Beatrice Electric Railway Company, states that the work of grading will begin shortly. It is expected that the road will be in running order within a year at the latest.

CINCINNATI, OHIO—The Cincinnati Rapid Transit Railway Company has been incorporated with a nominal capital, to be increased by $2,500,000 at an early date. It is proposed to build elevated and subway lines from Cincinnati to Dayton and to Norwood.

INDIANAPOLIS, IND.—The Indiana Union Traction Company announces that the Indianapolis Northern line from this city to Logansport, the Anderson line to Elwood, and the line from Alexandria to Muncie, will all be in operation by the first of next year.

ARDMORE, I. T.—The Sulphur Springs Railway Company has mortgaged its road running from Sulphur to Scullen, a distance of about eight and one-half miles, to the St. Louis Union Trust Company for $500,000, for the purpose of constructing its line of railway from Scullen to Sulphur.

INDIANAPOLIS, IND.—The Indiana Coal and Traction Company has filed a $5,000,000 mortgage, covering fourteen miles of electric road, operating from here to Plainfield, and 165 miles to be constructed to Terre Haute and Rockville. It is to be operated as an electric coal-carrying road.

MADISON, WIS.—The Chicago and North-Western Lakes Electric Railway Company, Alexander Clark, president, has filed an amendment to its charter with the secretary of state, providing for the construction of a branch line from the south state line, in Kenosha County, into the city of Milwaukee, forty-five miles.

SENECA FALLS, N. Y.—Electric road surveyors are doing the preliminary work on a projected line to Ithaca from Seneca Falls. Options have been obtained in the highway leading through the villages of Fayette, Ovid, Farmer, Lodi and Trumansburg. The plans are for a freight and express road, besides passenger traffic.

MADISON, WIS.—The Eastern Wisconsin Railway and Light Company, to construct and operate an electric line between Oshkosh and Fond du Lac and through contiguous territory, has been incorporated. The location of the company is at Fond du Lac. The capital stock is $500,000, and the incorporators are: Frank B. Hoskins, Benjamin Wild, Sr., and Leander Choate.

GREENCASTLE, PA.—The Greencastle, Waynesboro & Chambersburg Trolley Company is building a railway to unite Franklin and Adams counties. The line from Penmar to Waynesboro has been completed and put in operation, and the line from Waynesboro to Greencastle, a distance of nine miles, is fast nearing completion. It is announced that the whole line will be in use within a month.

ZANESVILLE, OHIO—Estimates for the twenty-two miles of railway which the Southeastern Ohio Railway, Light and Power Company purposes building from Zanesville to Sayer, *via* Roseville, Crooksville and intermediate points, have been completed, and it is reported that the cost of the undertaking will be somewhere between $800,000 and $850,000. Active work is to be started not later than February or March of next year.

BROCTON, ILL.—A number of citizens of Oakland recently held a meeting with a committee of Charleston citizens, for the pur-

pose of considering the building of an interurban line from Ogden, in Champaign County, to Charleston. Much interest is manifested in the project. The proposed line will extend from Ogden to Charleston, through Homer, Broadlands, Newman, Brocton, Oakland, Hindsboro, Rardin, Fair Grange and on to Charleston.

DAVENPORT, IOWA—Articles of incorporation of the Iowa City, Davenport & Muscatine Railway Company have been filed. The company has a capital of $1,500,000, and purposes to build an electric road from Davenport and Iowa City. The incorporators of the company are the Hon. Milton Remley, Stephen Bradley and H. B. Berry, all of Iowa City; Colonel E. J. Spencer, Thomas W. Crouch, L. S. Mitchell and L. B. Pierce, all of St. Louis.

HARTFORD, CT.—The annual meeting of the Hartford & Torrington Tramway Company was held recently and directors were elected. The officers are: President, M. C. Webster; vice-president, Walter Holcomb; secretary, N. E. Pierce, and treasurer, E. B. Mansfield. The two years' extension of time which was granted by the last legislature was accepted and the expectation of the directors is to build and connect with the line at Terryville within the limit.

WESTBORO, MASS.—It was practically decided at a meeting of the stockholders of the Westboro & Hopkinton Street Railway, held recently, to merge the line into the Boston Suburban Street Railway, which runs from Newton to Hopkinton. No formal vote was taken, but the election of a new board of directors was taken to signify that the lines will be merged, thus giving the Boston Suburban Railway another link in its proposed line to Worcester.

RUSHVILLE, IND.—The Indianapolis & Cincinnati Traction Company has purchased the entire line of the Indianapolis, Shelbyville & Southeastern. Directors have been chosen as follows: Messrs. Ball, of Muncie; Stanton, of Anderson; Hough, of Greenfield; Wild, Gardner and Reed, of Indianapolis, and Claude Cambern, of this place. At a meeting of the directors officers were elected as follows: President, Mr. Ball; secretary, Mr. Reed; treasurer, Mr. Wild.

NASHUA, N. H.—It is stated that a deal consummated here practically makes an electric road certain between this city and Manchester, in the next few months. Officials of the Goffs Falls, Litchfield & Hudson Electric Railway Company have filed a mortgage conveying to the American Loan and Trust Company, of Boston, all the property they may acquire, to secure $300,000 in five per cent, twenty-five-year gold bonds, maturing July 1, 1928. This road will complete a through line from Concord, N. H., to Boston.

MEMPHIS, TENN.—The Shelby County Traction Company has filed its charter, proposing to build an electric railway from Memphis to Collierville, about eighteen miles. The line projected passes through Aulon, Buntyn, White Station, Ridgeway, Germantown, Forest Hill, Bailey's and Neville. It is also proposed to build an electric light plant at Collierville, and furthermore to furnish light all along the line. The incorporators are T. J. Latham, H. C. Williamson, Thomas Wellford, J. M. Goodbar, J. M. Hill and I. B. Hudson.

WEST CHESTER, PA.—To promote a trolley line between West Chester and Pottstown a number of farmers residing along the proposed route have organized the Pottstown & West Chester Improvement Company, with these officers: President, Bayard A. Conard, of Font; vice-president, Frank Green, East Goshen, and secretary, Horace Fetters, Upper Uwchlan. The proposed trolley will pass through Oaklands, Whitford, Lionville, Eagle, Font, Ludwig's Corner, Nantmeal Village and Pughtown, and will open up a country that is not touched by a steam road.

LOUISVILLE, KY.—The Cincinnati Municipal and Securities Companies having recently acquired the rights of way to Versailles through Central Kentucky, has begun work on the construction of a suburban railway from Frankfort to Versailles. This company recently purchased the Frankfort & Suburban Street Railway, and will connect with that line. A new company with $250,000 capital stock to construct the road will be incorporated, with leading Frankfort and Cincinnati people as officers and stockholders. Ample capital is already in possession of the company to complete the construction and equipment.

NEW YORK CITY, N. Y.—The state railroad commissioners of New York are considering the application of a New York city interborough railway company for permission to construct an electric railroad in certain streets and avenues in the Bronx. The Union Railway Company, of the Bronx, is opposed to the plan and submitted a plan of its routes and the projected but unconstructed lines of the People's Traction Company to show that the Bronx is adequately supplied with transit facilities. The plans of the proposed interborough lines show them crossing the Union and People's Traction lines at forty-six points.

AUSTIN, TEX.—The charter of the Wichita Falls & Oklahoma Railway Company has been filed for record in the office of the secretary of state. The purpose of the company is to build and operate a line of railway from Wichita Falls northeast to the Red river, at a point in Clay County, a distance of thirty miles. The general offices of the company will be located at Wichita Falls, Tex., and the incorporators are Morgan Jones, of Denver, Col.; N. Harding, D. T. Bomar, W. E. Kaufman, A. M. Young, J. G. Wilkinson, E. W. Taylor, Ben W. Fonts and H. C. Erdington, of Fort Worth; Frank Fell, of Wichita Falls. The road will be extended north from the Red river to points in Oklahoma, and will connect at Wichita Falls with the Fort Worth & Denver City and the Wichita Falls railroads.

INDIANAPOLIS, IND.—A deal for a valuable piece of ground in the business part of Muncie has been practically closed by the Indiana Union Traction Company. It will probably be used for the site of a large union station for a number of the electric traction lines entering Muncie. The roads that are to use this station, if the project should carry, are the Muncie & Portland Traction Company; the Muncie, Hartford City & Ft. Wayne Traction Company; The Dayton & Muncie Traction Company, and the two lines out of Muncie of the Indiana Union Traction Company. It is stated by officials of the Indiana Union Traction Company that if the new station is had it will not mean that the headquarters of the company will be removed from Anderson. The building will probably cost in the neighborhood of $75,000.

CANTON, ILL.—Stockholders of the Illinois Central Electric Railway Company recently held their organization meeting in the company's general office in the Randolph Building, Canton, Ill. Fred A. Dolph was chosen chairman and D. J. Peffers, secretary. A committee consisting of O. J. Boyer, E. A. Heald and R. F. Henkle was appointed to present nominations for the board of directors. On their recommendations the following board was selected: U. G. Orendorff, W. O. Dean, R. F. Henkle, James A. Lawrence, E. A. Heald, W. D. Plattenburg, George Shawver, William Hanlon, M. W. Rafferty, L. W. Morton, Fred A. Dolph, J. W. Gaddis, C. L. Whitnah, J. L. Andrews, James David. The board then organized and chose the following officers: President, U. G. Orendorff; vice-president, W. O. Dean; second vice-president, R. F. Henkle; third vice-president, J. A. Lawrence; secretary, W. D. Plattenburg; treasurer, E. H. Heald. The term of officers and members of the board of directors will expire at the annual meeting in January.

MARLBOROUGH, MASS.—The Marlborough & Framingham Street Railway Company has been authorized by the railroad commissioners to issue $105,000 new stock at par for the purpose of owning, holding and operating the street railway property formerly belonging to the Marlborough Street Railway Company, and purchased at a receivers' sale. In November of last year the Marlborough company was unable to meet $113,000 damage claims growing out of an accident, and, after offering to compromise for $25,000, which offer was refused, applied for a receiver. The company owned and leased about fifteen miles of road. It has $80,000 of stock and the same amount of six per cent bonds outstanding. It has paid no dividends the last two years. For the year 1901-1902 gross earnings were $64,559; net, $17,544, and interest at six per cent, taxes, etc., $20,421, thus leaving a deficit of $2,877. The Framingham road, which, with the above, forms part of the Boston & Worcester Electric Company's system, has authorized an outstanding $60,000 of stock and $60,000 of five per cent bonds. This is exclusive of the new stock issue authorized. For the year ending September 30, 1902, net earnings were $9,859 and a surplus left, after charges of $4,245, of $5,614. The company operates seven and one-half miles of track between Framingham and Marlborough.

PERSONAL MENTION.

MR. HENRY SANGER SNOW has resigned the presidency of the Brooklyn Polytechnic Institute.

MR. RICHARD H. RICE has been engaged by the General Electric Company, Schenectady, N. Y., as steam consulting engineer. Mr. Rice is a graduate of Stevens Institute.

CAPTAIN JAY J. MORROW, Engineers, U. S. A., has been detailed for duty as assistant to the Engineer Commissioner of the District of Columbia, succeeding Captain H. C. Newcomer.

MR. N. J. HIGHLEY has tendered his resignation as superintendent of the Belvidere (Ill.) Gas and Electric Company, to accept the managership of the Iowa City Gas and Light Company.

MR. C. F. MACGILL has tendered his resignation as mechanical superintendent of the Canadian General Electric Company's works, at Peterboro, to accept a similar position with the Westinghouse company, Pittsburg, Pa.

MR. JOHN MUSTARD has established an office at 1617 Real Estate Building, Philadelphia, and will represent several electrical specialty manufacturers. Mr. Mustard was formerly with the Wagner Electric Manufacturing Company.

MR. CHARLES T. BISHOP, formerly with Ladenburg, Thalmann & Company, New York, and late paymaster of the U. S. Naval Service, has been appointed auditor of the H. W. Johns-Manville Company, 100 William street, New York city.

PROFESSOR A. MARSTON, of the civil engineering department of the Iowa State College at Ames, Iowa, has been appointed by the government to take charge of the civil engineering exhibits of the various colleges and schools at the St. Louis Exposition.

MR. WILLARD L. CANDEE, manager of the Okonite Company, Limited, New York, accompanied by his wife and daughter, sailed November 4 on the Cedric for Liverpool. Mr. Candee will be abroad for six weeks, making his headquarters at the Hotel Cecil, London.

MR. ALFRED T. CALL, late engineer in charge of tests of torpedo boat destroyers for J. J. Thornycroft & Company, of London, England, is now in Ontario, Canada, investigating a new steam turbine of Canadian manufacture on which he has made some successful tests.

MR. JOHN W. GODFREY, who for the past eleven years has been chief electrician for the United Electric Light Company, Springfield, Mass., has been appointed chief engineer of the New Milford Power Company. Mr. Godfrey entered upon his new duties November 1.

MR. IRVING H. REYNOLDS will shortly retire from the Allis-Chalmers Company, and the duties of chief engineer will be assumed by the engineers in charge of the various departments, these engineers availing themselves of the advice of Mr. Edwin Reynolds, consulting engineer of the company.

MR. T. C. FRENYEAR, for eight years manager of the Buffalo branch of the Westinghouse Electric and Manufacturing Company, has been appointed to take charge of the Toronto office of the new Canadian Westinghouse Company. Mr. T. Frank Dryden will have charge of sales in the Toronto district.

MR. W. H. ZIMMERMAN, M. E., who for the past two years has been on the engineering staff of the Arnold Electric Power Station Company, has been appointed general manager of the De Kalb-Sycamore Electric Company, De Kalb, Ill. Mr. Zimmerman is a graduate of the University of Illinois, class of '97, where he received the degree of mechanical engineer.

PROFESSOR HARRY C. JONES, Ph. D., of Johns Hopkins University, recently delivered a lecture before the Brooklyn Institute, department of chemistry and physics. The subject of his address was "Physical Chemistry." Professor Jones will shortly deliver another address at the same place on "Application of Certain Physical Chemical Generalizations to Organic Chemistry."

M. EMILE GUARINI, the well-known engineer and technical writer, has translated into French a series of articles on wireless telegraphy, originally published in the *Scientific American*. These describe briefly the early work on wireless transmission of signals, in which the translator himself took part. Marconi's work is described in full, and the theory of the propagation of electrical waves is discussed.

MR. H. G. TYRRELL has been appointed chief engineer of the Brackett Bridge Company, with works at Glendale, Ohio, and office at 83 Atlas Bank Building, Cincinnati, Ohio. Mr. Tyrrell is a well-known author and authority on engineering subjects, and has often contributed articles to the engineering press, both in America and Europe. His best-known books are "The Bridge and Structural Index," "Mill Building Construction," and "American Park Bridges."

ELECTRICAL SECURITIES.

It seems probable that within a short time there will come a breaking away of the sentiment that the iron and steel industry is a more or less true barometer of financial and industrial conditions. For a long time, under rush order conditions, the steel industry presented a stable appearance and paralleled the railroad industry, so that these two were allied as indicating the general conditions. At the present time, however, with a persistently declining steel market, the railroads, which appear to be a better index of the general prosperity, are steadily showing increased earnings and an improved passenger and freight movement. No one doubts the importance of a decline in iron and steel products, but this should not be allowed to balance the whole of the industrial community. Retrenchments which have been setting in, and which will, no doubt, be inaugurated, are dictated by good business policy, and the cut in prices of iron and steel will probably have the effect of stimulating new buying and new construction. This, in turn, will put more operatives to work, which, in its turn, will create a better circulation in all quarters.

It is confidently expected that the monetary situation will hold about the same until the end of the year. Banking interests will be forced to execute some probably drastic measures in order to meet the heavy first-of-the-year disbursements, when there is a general settling up of business accounts. The fact that the business community has been able to show up during the waning months of the year in as good shape as it has, augurs well for a resumption of business on a normal basis with the beginning of the year, and at least a reasonable percentage of the prosperity of the last few years can be expected.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 7.

New York:	*Closing.*
Brooklyn Rapid Transit	35⅝
Consolidated Gas	177
General Electric	147
Kings County Electric	150
Manhattan Elevated	136½
Metropolitan Street Railway	109½
New York & New Jersey Telephone	140
Westinghouse Manufacturing Company	165
Boston:	*Closing.*
American Telephone and Telegraph	126½
Edison Electric Illuminating	240
Massachusetts Electric	76
New England Telephone	122
Western Telephone and Telegraph preferred	75
Philadelphia:	*Closing.*
Electric Company of America	7⅜
Electric Storage Battery common	45
Electric Storage Battery preferred	45
Philadelphia Electric	5⅞
Union Traction	43⅞
United Gas Improvement	79¼
Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	140
Metropolitan Elevated preferred	56
National Carbon common	17½
National Carbon preferred	87
Union Traction common	7
Union Traction preferred	30

Northwestern Elevated for October carried daily an average of 71,617 passengers, an increase of 2,055.

The daily average of passengers carried during October on the South Side Elevated was 85,788, a gain of 2,676.

Metropolitan Elevated carried for October a daily average of 117,387 passengers, a gain of 1,407.

INDUSTRIAL ITEMS.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is sending out samples of its "O. K." duplex telephone wire. This wire is made in three colors—brown, maroon and black. Samples and prices may be had on application.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, is distributing an attractive folder entitled "There Is Light Within." This company will be pleased to send a sample shipment, subject to return at its expense, to any consumer who has not commenced the use of this carbon.

THE HAWKS ELECTRIC COMPANY, 156 Pearl street, Boston, Mass., has on hand a complete equipment of electrical apparatus for a modern factory plant. This includes generators, switchboards, motors, etc. In addition to this there are several bargains in engines, generators, etc.

THE SIMPLEX ELECTRIC HEATING COMPANY, Cambridgeport, Mass., has just issued a catalogue descriptive of electric laundry and tailor's irons. The catalogue deals with the subject of electric pressing irons in a manner which will be appreciated by the progressive manufacturer who is seeking advanced ideas and methods. Copies will be sent on request.

THE WHEELER REFLECTOR COMPANY, 156 Pearl street, Boston, Mass., will be pleased to send on request its catalogue No. 25. This is descriptive of reflectors, shades, clusters, large chandeliers, headlights, lanterns, street fixtures and other electrical specialties. The catalogue contains illustrations, sizes and prices, and covers every condition where plain or ornamental lighting is desired.

THE THERMO-ELECTRIC COMPANY OF AMERICA, Indianapolis, Ind., has been incorporated with a capital stock of $1,000,000, under the laws of Nevada. This company has been formed to promote the invention of H. Barringer Cox. This is a thermoelectric generator which not long ago was given considerable notoriety in the daily press. This apparatus, it is stated, transforms heat vibrations into electricity.

THE NATIONAL ACME MANUFACTURING COMPANY, Cleveland, Ohio, is distributing a very useful catalogue and price list of its product. This consists of milled screws, and set and cap screws in both V and United States standard threads, in both iron and steel. The catalogue is indexed so that it is possible to locate immediately any distinct type of screw or other article. This catalogue will be sent on request.

THE ANDERSON ELECTRICAL SUPPLY COMPANY, Anderson, S. C., has been organized to do a general business in electrical supplies and construction. The company is composed of Mr. E. S. Moorer, manager of the Anderson Telephone Company, and Mr. G. W. Evans, a business man of Anderson. This company will carry a full line of electric light and telephone supplies, and will do all manner of electrical repairs and construction.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has added another series of bulletins to its advertising literature, all of which are of great interest and of practical value. These are bulletins 4339 and 4344, respectively, and describe and illustrate in detail automatic circuit-breakers, type M, for 600-volt direct-current circuits; Meridian lamps; standard photometer lamps; list of polyphase power plants, and slow and moderate speed motors, type M. P., form H.

THE EDISON ELECTRIC ILLUMINATING COMPANY, Boston, Mass., in the November number of *Edison Light*, gives a number of interesting sketches on the use of electric illumination in and around Boston. A description is given of the new chimney at the L street station. The extreme height of the chimney is 250 feet 6 inches. The diameter from the outside walls at the base is twenty-four feet eleven and one-quarter inches. The diameter from inside walls at base is nineteen feet six inches.

THE BRYAN-MARSH COMPANY, New York and Chicago, has issued an attractive booklet entitled "The Views of the Electrical Editors." This contains several reprints of the descriptive articles which have recently been written, calling attention to the new Bryan-Marsh "Imperial" lamp. This is a new type of lamp which the Bryan-Marsh Company is placing on the market. It is so designed that, after reaching the eighty per cent line of candlepower, it burns out, so that there is no possibility of a dim lamp.

HENRY R. WORTHINGTON COMPANY, New York, is building a centrifugal pump of novel design and great capabilities for exhibition at the St. Louis Exposition. This pump is a departure from the usual centrifugal practice. It will be capable of delivering about 500 gallons of water per minute against a head of 250 pounds per square inch, and with high efficiency. This pump is of the type known as the multi-stage, turbine centrifugal, and differs in a number of respects from the centrifugal pumps with which engineers have been familiar.

THE H. B. CAMP COMPANY, Chicago, Ill., will be pleased to send upon application a circular describing the Lake divided conduit. A patent has been issued for this conduit under date of October 27, 1903, to Mr. Edward N. Lake. The goods are being manufactured under this patent by the H. B. Camp Company. This form of tile, instead of having its walls split so that the joints are diametrically opposite with respect to each other, is so divided that the joints in the opposite walls are offset. When the tile is laid, the joints in any one tile will be opposite with respect to the joints in the tile adjacent.

THE NATIONAL OIL BURNER AND EQUIPMENT COMPANY, of St. Louis, is placing on the market the Branch life net for elevator shafts, invented by Mr. Joseph G. Branch, chief inspector of boilers and elevators, St. Louis. This device is placed at the bottom of elevator shafts, so as to catch a body falling down the shaft, preventing fatalities due to such accidents. It consists of a net held on two sides by rods which are supported on each end by strut arms. The lower ends of these arms fit into bearings in pillow blocks, which are bolted to a stout plank. This plank is securely fastened to the bottom of the shaft. The end is held taut by large compression springs acting at the upper ends of the strut arms. The springs are supported and held in place by pieces of large pipe, and are free to move along these pipes. When a falling body strikes the net, the fall is broken by the net, combined with the action of the springs. The net will give and sag, and the arms close up. The pipes are also free to move endwise through proper openings made in the upper ends of the strut arms, permitting them to close in and break the force of the fall.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., manufacturer of the chloride accumulator, has recently closed a contract through the Canadian General Electric Company, Limited, its representative in Canada, for an installation in the power-house of the Toronto Railway Company; this battery consists of 276 cells, having a capacity of 3,000 amperes. A contract has also been closed with the Bangor Public Works, Bangor, Me., for a railway battery consisting of 264 cells, having a regulating capacity of 160 amperes. This battery has containing-cells of sufficient capacity to allow of a future increase of fifty per cent. The Carnegie Steel Company has contracted for the installation of a battery in its Youngstown, Ohio, works for use in regulating the fluctuations of load, due to the starting and stopping of motors, this battery having a capacity of 1,600 amperes at 260 volts. The Chicago Edison Company has contracted for a battery for its Haddock place station, having a capacity of 16 to 800 ampere-hours at 128 volts. Contracts have also been closed with the United States Government for a battery at Fort Totten, consisting of 62 to 640 ampere-hour cells; the Stevens Building, Detroit, Mich., 140 to 160 ampere-hour cells; the House of the Good Shepherd, Roxborough, Mass., 62 to 160 ampere-hour cells, and Johnson-Kahn Company, 68 to 560 ampere-hour cells; these latter installations being for light and power work.